THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 24. Thursday, December 15th, 1921. No. 278.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

The Foundry Trade Journal,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI, LONDON, W.C.2.

Contents.

	PAGE
Forthcoming Events	475
Experimental Accounts	475
Metal Moulds in the Foundry	476
The "Doelcam" Sand Blast Table	477
Avoiding the Use of Chaplets	478
Employment in Lead Processes	478
Book Reviews	478
Iron Foundry Problems	479
Silumin Metal	482
The Determination of Lead in Brass	482
Gas in the Foundry	483
Export of German Wire Ropes	486
Reclaiming Moulding Sand	486
Institution of British Foundrymen	487
Trade Talk	490
Iron and Steel Markets	491
Company News	492
Personal	492
Gazette	492

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

Institution of British Foundrymen.

PRESIDENT, 1921-1922: Mr. Oliver Stubbs, M.I.Mech.E., Openshaw, Manchester.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, Bessemer House, Adelphi, Strand, London, W.C.2.

Manchester: J. Hogg, 365, Manchester Road, Burnley, Lancs.

Birmingham: F. B. Holberry, 22, Salisbury Road, West Bromwich.

Sheffield and District: W. A. Macdonald, 62, Bannerdale Road, Sheffield.

Scottish: W. H. Bound, 16, Grantley Gardens, Shawlands, Glasgow.

London: V. C. Faulkner, 21, Stanley Gardens, W.11.

Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.

East Midlands: H. Bunting, 17, Marcus Street, Derby.

Coventry: F. H. N. Lane, 46, Holyhead Road.

West Ridings of Yorkshire Branch: T. Johnson, 32, Wensley Dale Road, Bradford.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Cardiff.

Forthcoming Events.

Institution of British Foundrymen.

Sheffield Branch.—"Fluidity of Molten Metals," by Prof. C. H. Desch, on December 19.

East Midland Branch.—"Foundry Facings," by H. Winterton, on January 21, 1922, at Loughborough.

Coventry Branch.—"Foundry Training," by T. Vickers, on January 11, 1922.

Sheffield Association of Metallurgists and Metallurgical Chemists.

"The Effect of Solders on Beta Brasses," by J. H. S. Dickenson, on December 20.

Staffordshire Iron and Steel Institute.

"Cast Iron for Foundry Purposes," by F. S. Wilkinson, on December 17.

Experimental Accounts.

When visiting foundries we have been impressed with the amount of plant standing derelict. The reasons given to us may be briefly summarised as bad trade, change of type of manufacture, high costs, and mechanical inefficiency. But quite often, and recently publicly, hints of misrepresentations by sellers have been put forward. An investigation of cases of this nature usually reveals the fact that the seller is in a position to show a similar machine operating successfully and economically in another works, otherwise the seller would quickly be out of business. This seems to point to the conclusion in many cases that the buyer has not made a success of the particular plant on account of its use for an unsuitable product. We readily grant that conditions have rapidly changed since the war, and plant bought during that period may have been rendered useless owing to the new conditions. But there still remain a large number of cases where either prejudice or inefficiency on the part of the buyer exists, and it is with such cases that we are dealing. Very often a bad delivery initiates the dispute, and this bad feeling grows with the continuation of the relationship. Such conditions should no longer obtain. The next important factor is the auxiliary arrangements provided by the buying firm, which may not coincide with those desired by the seller. Here again is a fruitful cause for disputes. A further factor is ignorance on the part of the buyer as to the possibilities of the machine supplied and by the seller as to the nature of the product required from it.

Obviously, the buying of new plant is one which cannot have too much thought bestowed upon it, and we would suggest that the problem should be divided into three categories, the first of which is where operating details of the unit are so well known that no doubt exists of its utility to the buyer. In the second category comes plant which, as far as can be ascertained, is reasonably sure of paying for itself, but is quite novel as far as the buyers are concerned. In such cases the plant can be immediately credited to the plant and machinery account, but there should be created for its operation over a predetermined period an experimental fund on which the plant can draw. After such a period the plant would be expected to pay for itself. The third category comprises machines which are new applications to the industry under consideration, and for such plants a separate grant should be made to cover its purchase, erection, starting up, and for a few months' work. It seems apparent, therefore, that an experimental account should be opened, not only in fairness to the seller, but also for the manager, whose very position rests on production. We have on many occasions been perturbed when a request has been made by the direction to incorporate in a plant or process which is contributing to profits, some experimental work for the covering of which there exists no special funds, well knowing that profits were at least forced temporarily to suffer.

When a machine is in successful operation it is only fair that its product should be made to repay to the experimental fund all moneys received from it so that the condition of the experimental account will always be a reflection on the foresight in buying and processing of the people responsible.

It is certainly to the interest of the buyer, his managers and foremen, as well as for the seller that such a fund should be created. When money is plentiful commercial disputes are rare, but when money is scarce law cases become more common.

It cannot be too strongly impressed upon foundry managers and foremen that they should strive for such conditions to be initiated in their works.

XUM

Metal Moulds in the Foundry.*

By S. A. E. Wells.†

In a general sense the casting of metals in the foundry falls under two main headings:—

(1) Methods in which sand is employed for making moulds and the moulds are unavoidably destroyed in removing the casting.

(2) Methods where metal moulds are employed and used time after time. The use of metal moulds may be divided into three classes:—

(a) That in which the metal flows into the mould solely under its own weight.

(b) Where additional externally applied pressure is used to force the metal into the mould.

(c) When the mould consists in part only of metal.

Gravity Castings.

Included in the first class are moulds which are used for the production of ingots, strips, billets, etc., for subsequent mechanical treatment in the manufacture of wrought metals and alloys.

These moulds vary considerably in size and shape and are mostly made of cast-iron, one possessing a close fine grain being preferred.

In making cast-iron moulds for producing repetition castings as bases for the manufacture of wrought material, a number of factors must be considered. The mould must be of a very convenient form, capable of being opened and closed in a minimum time with low labour charges. It must also be constructed of such a size that the abstraction of heat is regulated to produce a uniform grain ingot.

Moulds are made in sections, usually halves, and are cast in sand to the shape desired. When casting these sections allowance is made so that they can be readily machined to fit one another, to permit of easy parting to release the solid casting.

The inside surfaces which are in contact with the molten metal are machined also, and "worked up" by means of emery cloth, thus providing a smooth surface which will be reproduced upon the finished ingot. The sections of the mould are finally clamped together, the most common method being by means of rings and wedges, a quick and very effective method.

The influence of the mould upon the metal poured into it should be considered in order to determine some standard of relationship between them.

Molten metal poured into a small cast-iron mould is cooled very rapidly, resulting in a fine uniform grained metal suitable for successful mechanical working. However, with increasing size of ingots the problem of producing a uniform grain becomes a more difficult matter.

In a large ingot of metal cooled from the molten to the solid state, when poured rapidly into a cold metal mould, the immediate effect of contact with the walls of the mould will be to "chill off" the surface layers of the ingots, following which, solidification works inwards from the walls of the mould, the centre being the last to solidify.

The centre remaining molten considerably longer than the rest is thus called upon to feed the remainder of the ingot, until liquid contraction ceases, therefore the centre will be seen to contract in the form of a rough inverted cone. Beneath this cone further contraction has probably occurred, and a chain of cavities formed which may extend a considerable way down into the ingot.

These are known as contraction cavities, and will be revealed upon suitably splitting the ingot vertically through the centre.

If a cross section of the ingot is taken somewhere about the middle of its length, and etched with a suitable reagent to develop the macro-structure, it will be found that the grain so revealed will vary considerably.

The layers in contact with the walls of the mould having solidified rapidly will be found to consist of a fine close grain, while the remainder will gradually increase in grain size the nearer the centre of the ingot its location.

It will now be understood that the centre of the ingot consists of a more or less coarse-grained core, the object must be the elimination of this core as far as possible by controlling the various factors effecting the rate of cooling. These may be conveniently classified as follows:—

(a) The pouring temperature of the metal.
(b) The rate of pouring the metal.
(c) The abstraction of heat by the mould.

Assuming the pouring temperature of the metal to be that generally accepted as the standard for the metal concerned and pass on to consider the rate of pouring. The rate of pouring will vary with the class of metal and type of ingot being dealt with, and is best settled by experiment.

Assuming the heat abstraction factor to be already settled, a pouring rate should be ascertained, so that a minimum amount of metal only remains molten in the mould at any time during pouring.

In this way the complete horizontal section of the ingot solidifies practically simultaneously in successive but undefined layers, each layer only being required to feed the one immediately beneath it.

Thus when the mould is completely filled what liquid contraction remains to take place is small and may be readily followed up with molten metal. Piping of the ingot is therefore arrested and minimised.

The rate of pouring is best controlled by tilting the mould forward to an angle of 15 to 45 degs. to the floor, and pouring the metal in a steady continuous stream down the incline formed by the lower surface of the mould, and by employing some mechanical means of concentrating the stream in the mould.

The concentrating of the stream so that its surface is small is most necessary where very slow rates of pouring are employed, in order that the stream may retain its temperature instead of dissipating heat by straggling about the surface of the mould in a comparatively thin film.

Some types of moulds are of such a shape that one may accomplish this by utilising the particular shape of the mould to this end. Small diameter billet moulds and square section moulds are some of these types; in the latter case the angle formed by the junction of two sides is made use of.

The casting of strips is one of those cases where control of the stream is essential and difficult.

(To be continued.)

* A Lecture read before a Joint Meeting of the London Branch of the Institute of British Foundrymen and the Institute of Metals last Thursday.

† Mr. Wells is connected with the National Physical Laboratory.

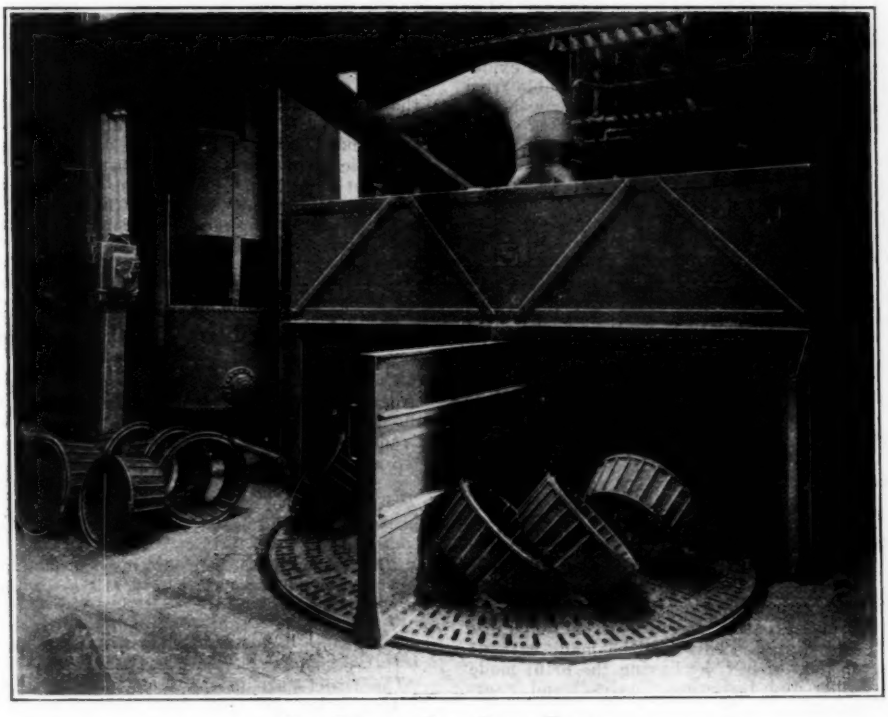
HEAT-TREATMENT OF COPPER ALLOYS.—An application for a patent has been filed by Isabellen Hütte Gesellschaft, of Dillenburg, Hessen, Nassau, and relates to the heat-treatment of copper alloys. It consists in subjecting alloys of copper, manganese and other metals, such as aluminium, zinc, tin or silicon, after they have been cast, rolled or forged, to a prolonged heating at a temperature below red heat. In an example an alloy consisting of 10-15 per cent. manganese, 10-15 per cent. aluminium, the remainder being copper, which, when rolled, annealed and cooled, has a tensile strength of 42 tons per sq. in. and an elongation of 21 per cent., after being subjected to a temperature of 220 deg. C. for twenty hours, showed a tensile strength of 61 tons per sq. in. and an extension of 0 per cent. The hardening is stated to render the metal suitable for the manufacture of knives. A marked hardening effect takes place in the case of brass alloys containing a high proportion of manganese. Such an alloy containing 51 per cent. copper, 40 per cent. zinc, and 9 per cent. manganese, after rolling at a high temperature, forging and annealing at 600 deg. C. and cooling, shows a tensile strength of 34 tons per sq. in., extension 11 per cent., and a Brinell hardness of 166. After heating for thirty-six hours at 230 deg. C., the same alloy shows a tensile strength of 38 tons per sq. in., extension 2 per cent., and a Brinell hardness of 260. Manganese, silicon and copper alloys hardened by this method at temperatures of 200 to 400 deg. C. may be used in place of tin alloys for bearing liners.

The "Doelcam" Sand Blast Table.

The Doelcam sand blast table, of which the selling agents are Messrs. Ronald Trist & Company, Limited, 12, Clipstone Street, London, W., is entirely self-contained, having for work within its capacity an efficiency equal to the ordinary sand-blast room, without the operator working in the dust-laden air. It is complete with cleaning cabinet, hand-rotated turn-table, abrasive handling, and reclaming equipment, storage tank and positive pressure blast machine.

The semi-circular cabinet is constructed of sheet steel, the shell proper being protected from the abrasive action of the sand by a lining of rubber sheeting. The cabinet is 6 ft. high on the top sloping from this height to 4 ft. 6 ins. on the top outside. Observation screens, furnished with shades, are provided in the sloping top of the cabinet, thus enabling the cleaning operations to be watched from outside the cabinet.

The opening through which the nozzle is directed extends for the full width of the cabinet, so that work placed on any part of the table may be conveniently reached by the blast. The nozzle opening is approximately 12 ins. wide and 36 ins. high from floor. Two electric lights, located in the top of the cabinet in dust-proof fixtures, thoroughly illuminate the whole of the chamber.



THE DOELCAM SAND BLAST TABLE.

The cleaning cabinet encloses one half of the table at all times, a hopper is provided in the bottom of the cabinet, under the table, the used sand flowing by gravity to the bottom boot of the sand elevator. The exhaust pipe is located near the top of the table on one side of the cabinet, so that all dust-laden air is drawn down towards the table and away from the observation screens.

One half of the cleaning table (7 ft. in diam.) is within and the other half at all times without the cleaning cabinet. The principle of operating being that while castings or work to be cleaned are placed on the exposed half of the table, the operator is blasting on the opposite half in the cleaning cabinet.

The table is built up of beams supported on a massive cast-iron centre, the table proper being former of slotted segments, which are renewable. The whole table structure is mounted upon a vertical shaft, resting upon a ball thrust bearing, which is enclosed in a dust-proof housing, a ball-bearing is also provided at the top of the shaft, so that the operator can easily rotate the table, when fully loaded with castings, with one hand.

The construction is such that the top of the table is some 20 in. from floor level, so that a small pit is required for the accommodation of the bottom boot of the elevator. The bottom of the table is provided with a sand scraper, by which the sand is kept within the cabinet and finally delivered to the boot of the bucket elevator, the necessary supply of fresh sand is shovelled on to the exposed half of the table. The partition or door, which extends over the full diameter of the table, is attached to and rotates with the table.

The sand blast machine is of the positive pressure type, the tank having a capacity of 1,000 lbs. An automatic filling valve is fitted in the top of the machine in line with the bottom of the sand storage tank. This valve operates automatically, in that when the air to the machine is turned off, the valve automatically opens, permitting all the sand stored in the storage tank to fall by gravity into the sand blasting machine, and so soon as the air is again turned on, the valve automatically closes, rendering the machine ready for operation. The storage tank has a similar capacity to the machine placed immediately above; above this tank is a triple sand separator, which comprises two oscillating screens, the first separating all refuse from the sand, and the second the good, sharp sand from the very fine and useless material. The sand screen is driven from the driving shaft of the elevator. The elevator of the belt and bucket type is built up of malleable-iron buckets, which are secured to a heavy rubber belt.

The dust arrester contained in a steel housing, comprises a series of frames which provide a total of about 1,100 sq. ft. of filtering cloth. The frames are tapering in form, wider at the top than the bottom, and are suspended at the top only, hanging loose at the bottom. This arrangement not only permits the dust being easily jarred from the cloth, but when loose allows it to fall to the bottom of the housing without hindrance. Furthermore, the screens being pivotted at the top makes it possible to get a good vibration on the screens with the jarring mechanism in operation, so that the pores of the cloth are kept open, which greatly increases the efficiency of the apparatus, as the retardation of the suction of air in the cleaning cabinet is reduced to a minimum. It will be noted that the exhausting fan only handles air, all the dust being collected in the arrester. Furthermore, the abrasive being lifted by mechanical means, and not by the exhaust fan, as is fairly usual, a saving in power is effected and the wear on the fan is reduced.

XUM

Avoiding the Use of Chaplets.*

Chaplets are of various designs and types, but all serve the same purpose, that of holding the core in position during the time of casting and until the metal solidifies. After that, their usefulness ceases, and they become a source of weakness to the casting, causing leaks while under pressure and breaks under strain at the points of the chaplet stems. On any surface to be machined they are by no means desirable, as they cause hard chilled spots and blowholes, thereby causing endless trouble.

Whilst chaplets cannot or ought not to be done without altogether, where a sound job is desired there is no occasion to use them to the extent now witnessed in everyday jobbing foundry practice.

A cylinder casting, for example, for the starboard side of a boat had 32 chaplets on the top of it, and the same cylinder on the port side had four chaplets. This represents two different moulders' ideas of a good job.

Fig. 1 represents a piston for an internal combustion engine, made in such a manner as to require three chaplets on top A, and three on sides A, to keep the core perpendicular. The result of such a method is, a casting dirty and weak on the piston crown, where the greatest strength is required to take the force of the explosion in the cylinder. It also creates trouble from the chaplets on the outside driving machinery and blowholes.

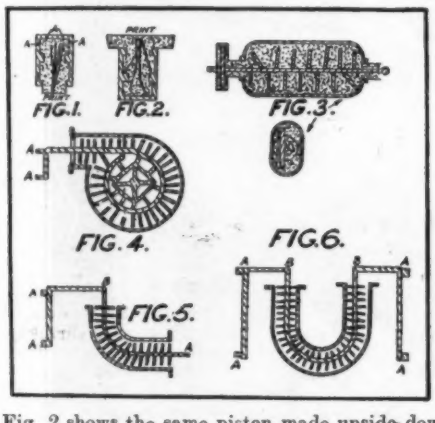


Fig. 2 shows the same piston made upside down, the core hanging by a print from the top. No chaplets being required, a sound crown is obtained by having the greatest pressure of metal where strength is required. This may be made without using a top part of box, by having the print made a little deeper and fastening "gates" and risers on the pattern.

Fig. 3 shows an oval casting, 18 in. × 10 in. × 3 in., having two outlets 2 in. diameter. This was made using four chaplets, top and bottom. Two would have held the core down, but four were used to prevent canting, by having one end of the core continued out about 2 in. and putting on a square piece, as shown, and print to correspond on pattern. The job was successfully made without the use of any chaplets, and gave a core easily handled, care being taken to make the ends of the core iron secure by means of a rod through the top to rest on the ends of the core iron. In making a core iron such as this the centre bar ought to be heavy enough to carry at least five times the weight of the core. As the upward pressure equals four times, plus the movement of the fluid metal, the toes ought to be fairly light, and by striking the bar directly on the end the toes are stripped off, when the core can be cleaned out easily.

Fig. 4 shows a section of a centrifugal pump body.

The core iron is made with a balancing leg and disc in the centre AA. This gives three points to hold the core down. The balance leg and that alongside of it are held down by the same method as in the last illustration. When making the core a making-up piece is placed on top of the disc cast in the core iron. The centre core is then made on a piece of tube similar to a bore barrel, having one end flush with the bottom of the core. This is taken through the top part, and gives the principal means of holding down the core. In small bodies a piece of ½-in. iron is put in the centre core.

The usual method of making pump bodies shows two and sometimes three chaplets, which are, to say the least of it, anything but ornamental to the casting. By this method we have a casting that looks better, and can be made as quickly, if not more quickly, than by using chaplets.

Fig. 5 shows a section of a bend pipe and core iron, while Fig. 6 shows a U pipe and core iron. The usual methods of making such articles are too familiar to require any explanation, and the sketches to a great extent explain themselves.

In putting these cores in the mould they are placed on pieces of wood the required thickness, according to the metal, and the balance leg and end of the core iron and made up iron to iron, at AAAA. After lifting out the core and removing the pieces of wood the core is placed back in the mould. Some may prefer to have a loose balance leg, that is, at B. A flat lug is cast on to the core iron, and a leg, which is included in shop tools, usually made like a large spanner to fit over the lug, is wedged on to the core iron. But that is a matter of fancy and does not concern the principle.

One of the reasons for writing this article is that it was said "Acid castings cannot be made in Australia." It may be explained that castings used in the manufacture of nitric, sulphuric, muriatic, and such acids must not have any wrought iron or steel chaplets in them, as the acid destroys such metal very quickly. Nothing but high silicon or high carbon irons will withstand the action of the acid.

* Extracted from the "Australian Hardware and Machinery."

Employment in Lead Processes.

The Home Secretary has made the following Orders, dated November 8, 1921, in pursuance of the Women and Young Persons (Employment in Lead Processes) Act, 1920:—

(*a*) Declaring what is a lead compound for the purposes of the Act, and prescribing the method of ascertaining whether any compound is a lead compound within the definition;

(*b*) prescribing the periodic medical examination required under Section 2 (1) (*b*) of the Act; and

(*c*) prescribing the cloakroom, messroom and washing accommodation to be provided under Section 2 (1) (*c*).

The Orders are in the same terms as the draft Orders issued in April last, except for a slight alteration in the wording of paragraph 2 of the Order prescribing the cloakroom, messroom and washing accommodation.

Paragraph 2 of the Order prescribing the medical examinations requires the employer to supply every woman and young person employed in any process to which the Order applies with a Health Register in the approved form. Copies of this Register (Form 616) and further copies of the Orders can be obtained directly from H.M. Stationery Office, Kingsway, London, W.C.2.

Book Reviews.

IRON FOUNDING, by B. Whiteley. Published by Sir Isaac Pitman & Sons, Parker Street, Kingsway, London, W.C.2. Price 3s. net. This little book, which is one of Messrs. Pitman's "Common Commodities and Industries" series, deals with the whole subject in an elementary way. The book is divided into fourteen chapters:—Historical Survey—Introductory—the Metal—Furnace Mixtures—Moulding (three chapters)—Foundry Equipment—Machine Moulding—Cores—Permanent Moulds—Malleables and Defects in Castings. The book is illustrated with some 24 figures, and is well suited as a text-book for apprentices and metallurgical students.

Iron Foundry Problems.

At a meeting of the Manchester Metallurgical Society held on November 22, Prof. E. L. Rhead, M.Sc.Tech., F.I.C., of the College of Technology, opened a discussion on "Iron Foundry Problems." He said, having in mind the vastness of the subject, he thought the best way to open the discussion was to enumerate some of the more important difficulties which had to be borne in mind in the manufacture of iron castings. These could be grouped under various headings. Those applying to the metal, moulding materials, method of production, metal melting, etc. Taking first those which arose from the composition of the metal, the strength of the casting depended partly upon the grain of the material, partly upon the size of the graphite flakes that were produced during the solidification and cooling of the metal, varying according to the manner in which it behaved during solidification, and, in some cases, the manner in which the casting was run. In the case of coarse-grained highly graphite irons there could be no question as to the difference in the strengths of the castings produced. He illustrated that point by a series of fractured test bars, in which the metal was essentially of the same composition but the separation of the graphite had occurred in different degrees of fineness.

Hardness, Shrinkage, and Specific Gravity of Cast Iron.

Hardness depended largely upon the amount of combined carbon. In theory chilling was merely an effect caused by the retention of the carbon in the combined form. Softening of castings was very largely the result of the separation of the carbon from the combined condition into the free graphitic state. Prolonged heat caused the disengagement and separation of the carbon in irons of different composition at different rates and temperatures.

Shrinkage varied in different types of iron; it depended almost entirely upon the extent to which graphite was produced in solidification. Passage from the liquid to the solid state always involved a diminution in volume; therefore one would expect the solid metal to be heavier than the liquid, but, on the contrary, in most cases it would float on the liquid, although of higher specific gravity when cold. During the cooling down there was separation of the graphite, a material with much lower specific gravity, and in consequence an actual increase in size after solidification. The increase in volume in the solid state at or near the melting point sometimes amounted to 7 per cent. of the casting without any oxidation or growth of any other type. So where the graphite was separated in a free condition during solidification they might have as a result a solid metal of lower specific gravity while hot.

Why would bulky lumps of material sink and light castings float on the top? The answer was quite simple. In the case of a light casting the metal was heated very rapidly by contact with the liquid, the natural expansion up to the melting point was secured very rapidly and at a temperature just below melting point it possessed a larger volume than it did in the liquid state. With a compact lump the heating process took place more slowly, the conduction of heat into the mass of the metal, so that it expanded in the solid state to the extent to which it would be at the high temperature required some little time; and it might sink first and rise almost immediately afterwards. The whole thing was bound up with the separation of the carbon into the graphitic state. All sorts of difficulties resulted from irregularities of contraction; the great shrinkages that might occur with certain types of iron led to fractures or distortion in the castings, but they were all minimised by the separation of the graphite during solidification and cooling down. That explained why, as the iron approached white iron, the greater the amount of contraction and the greater the danger of fracture or distortion of the casting.

The Influence of Sulphur.

The action of sulphur in preventing the separation of the graphite or the carbon in graphite condition, in cooling, was responsible for the effect which sulphur had in increasing the contraction and the difficulties of fracture and distortion of the castings, as well as the increased hardness of the metal.

Influence of Phosphorus.

In certain classes of castings pellets or "chips" of metal, a hard enclosure of a metallic type were commonly found.

These pellets consisted entirely of a very fluid residue that remained until solidification was almost completed. Its fluidity at so low a temperature—after the rest of the metal had solidified—was due to the presence of phosphorus; that fluid contained the whole, or nearly the whole, of the phosphorus contained in the iron. Rather more than 7 per cent. phosphorus might be found in the fluid remainder from iron which contained only 1 per cent. phosphorus. While the average melting point was about 1,200 deg. C., this residue remained fluid down to 950 deg. C., and it was squeezed by the contraction of the solidified metal into any cavities which existed. In the case of phosphoric irons cast in chills, when the outer skin was chilled solidification started very rapidly, and the eutectic phosphoric constituent which was fluid might be squeezed outside the casting through the pores of the crystallising metal. On the surface of one of the specimens exhibited the members would observe small warty excrescences, which appeared to be more like sand burnings than anything else. Originally they were all over the casting. They consisted entirely of this phosphoric liquid. The casting came out from the mould quite red hot, quite solid, uniform in colour on the surface; immediately afterwards it began to glow at different points all over the surface of the casting, and little sparks flew off. On examination it was found that at all points from which sparks were emitted there was a small pellet of the phosphide exuded from the casting—a little round pellet like a sand grain. In that case the phosphoric fluid was squeezed outside, but it could also be squeezed into any cavities that might exist in the interior of the metal. Where the metal solidified in different stages—one part solidifying while the other remained fluid—the inevitable result was the formation of cavities or shrinkage holes in the heavy parts of the casting. These shrinkage cavities were largely bound up with the nature of the metal and form of the casting. Any composition or form that tended to produce solidification in parts, in separate portions, or caused the separation of low melting point residues, would tend to produce that result unless feeding was resorted to.

Meeting of Metal Streams.

Sometimes the joining up of two streams of metal from different gates was largely influenced by the composition of the metal. The metal might be running rather slowly, and the front of the stream become cool and partly solidified, it was covered with a skin; but the still fluid portion continued to run forward. If it did join up properly there was a seam of metal or a line of metal more or less irregular, which was richer in the constituents which gave fluidity. Sometimes there was a very considerable difference in the composition of the metal at that point from what it was in the body of the casting.

Mould Facings.

Blacking was done for several reasons. In the first place it was to protect the mould. After that the intention was to prevent sand fusing and to give a reasonable skin to the surface of the casting. Quite often it caused difficulties of a peculiar character. Sometimes one found a series of small pin holes just below the skin that did not go far in—perhaps $\frac{1}{8}$ in.—dotted over the whole or part of the casting. In many cases they resulted from the use of an unsatisfactory blacking. Gas did not penetrate through the closer blackings. That was quite a good thing so far as the gas content in the sand or the material of the mould was concerned, but it was not a good thing as far as the gas contained in the metal was concerned, or that might be present in the cavities of the mould. The effect was

that the solidification of a skin of iron commenced, and that might be very rough indeed on the inner side, due to the crystallisation taking place. Gas bubbles had a tendency to attach themselves to the first solid matter with which they came into contact, and could not be easily dislodged. When the solidified portion came into contact with gases passing through the metal or separated from it, they were retained, and just under the surface there would appear a whole series of pin holes and pock-marks, which completely destroyed the value of the casting. He had in mind a case where very unsatisfactory results were being obtained with cylindrical castings; an examination of the blacking revealed the fact that it contained less than 25 per cent. of pure graphite, the residue being a clayey matter, which made it sufficiently adhesive to stick to the mould, but blocked the pores of the metal and prevented the gas getting away. Reversion to pure graphite removed the trouble.

Scabbing resulted largely from unsatisfactory venting. The blacking was lifted off the surface and carried forward with the stream of metal and became embedded in the mould, very often not far from the point at which the material was detached. Scabs were almost invariably associated with blow holes, the result of the gas attaching itself to the solid matter which the material removed from the mould when the scab was formed, or in many cases because of the expansion of the gas contained in the material.

Ramming and Venting.

Other troubles come under the head sand and ramming. Venting difficulties led to the production of blow holes through the gas not being able to get away, hard places through ramming being too effectively done, fractures due to the casting not being able to contract because of the extreme hardness and firmness of the mould, due to hard ramming, hard cores, or to the unsatisfactory nature of the sand or mixture employed.

Cupola Troubles.

Then there were the troubles arising from cupola mismanagement in the course of melting. They might be due to the different materials employed. But a satisfactory metal might not yield a satisfactory result for the simple reason that the melting was not conducted at a sufficiently high temperature owing to the fault of the designer of the cupola, the amount or nature of the coke, or the amount and distribution of the air blast, or the coke might transfer sulphur. It could be put down as a general principle that the lower the silicon and carbon content of the metal the more readily it would absorb sulphur from any material containing that element with which it came in contact. That difficulty cropped up when making a semi-steel by melting wrought iron punchings in the cupola along with the pig-iron. Very high temperature melting was necessary to secure the best results when melting for semi-steel in the cupola.

Exudation of Phosphide Eutectic.

MR. S. E. DAWSON said some interesting experiments had been made to see whether the phenomenon of the phosphate pellets would occur with low phosphorus irons. With a hematite pig-iron containing 0.05 per cent. phosphorus they got on the outside of the casting phosphide pellets, which showed, on analysis, 1.7 per cent. phosphorus. With iron containing 1 per cent. phosphorus, the pellets contained 6 to 7 per cent. phosphorus.

Influence of Carbon.

DR. F. C. THOMPSON agreed that the strength of cast-iron depended upon two factors, the size of the graphite flakes and the percentage of combined carbon—*i.e.*, pearlite—present in the casting. But they bore in rather different directions. In considering the tensile properties the graphite flakes, their size and distribution, were the chief factor, but under compression it was rather the amount of pearlite present which dominated the position. But there was one case where the distribution of the graphite was of importance. If cast-iron failed under compression, it usually did so by shearing, and if it so happened that the graphite flakes happened to fall in, a direction more or less coincident with that in which the shearing took place, the strength of the iron in compression was very appreciably reduced. The whole position with regard to the separation of graphite was anomalous. The ordinary text books gave a diagram which was flatly contradicted by the structure of grey iron. The flakes of graphite in an ordinary grey iron pointed to a precipitation of graphite from the liquid before solidification commenced, but according to the diagram they would only get graphite when the final stage of solidification was taking place. Any research that could be carried out to increase knowledge in connection with the conditions under which graphite was precipitated would certainly be looked forward to with interest. The combined carbon in the iron depended, of course, upon the rate of cooling. The structure that obtained after cooling was radically different if the rate of cooling appreciably altered.

Fusion of the Mould Face.

Another point was the burning-on of the sand. It frequently arose from the fact that the sand was somewhat impure; there were fusible constituents which attached themselves to the surface of the casting. In a large number of cases it was due, he thought, not so much to the impurity of the sand itself as to the fact that in the casting oxidised material was carried in which attached itself to the surface of the sand. Under these circumstances they had a fairly acid material on one hand, and a distinctly basic material on the other. By the use of a tun-dish in the casting it was much more easy to eliminate oxides, and in one particular case that he knew of the use of a tun-dish in the preparation of certain castings effectively overcame great difficulties which had been caused by burning-on.

A year or two ago some good work was done when investigating the highest temperature of annealing that could be used for chilled wheels. What was required was to anneal at as high a temperature as possible, but to leave the whole hardness on the surface unworked. It was shown that so long as the annealing temperature did not much exceed 700 deg. C., the whole of the stresses which could do harm were removed, while at the same time the amount and extent of the hardness on the surface was not appreciably affected.

MR. D. CAMPBELL said many troubles with defective test-pieces were probably caused by the test-piece being placed on a wrong part of the casting, allowing the sand to flow into it. Sometimes the mould had been holding the casting too tightly.

MR. R. A. MILES thought 2 per cent. was a very low figure for wasters in the best managed foundry. The difficulty of castings being fractured by very hard cores was being eliminated by the introduction of oil sand cores.

Influence of Silicon.

MR. H. SHERBURN said the subject was so vast that it was difficult to concentrate one's thoughts. They might have been better able to discuss a particular question, such as the chemical composition of metal or the facings for moulds. In foundry work the problems were so many and so varied that in the ordinary way of business they had hardly time to deal with them thoroughly. They simply did their best to get results, but in very few cases did they really get down to the root of the problem; they solved it probably in many cases but did not know the reasons why they solved it. To get proper information they must understand how and why, as well as achieve results.

Prof. Rhead had mentioned some of the ingredients that entered into cast-iron, but he omitted a very important one—silicon. Given good melting conditions, where the sulphur could not get too high, and other conditions were normal, they could almost control the material, and make sure of uniform good results by watching the silicon and maintaining it at that particular point, which was suitable for the type of work they were engaged upon. Of course it could not be suggested that the silicon content of the mixture must be the same for every class of material.

Test Bars.

In testing cast-iron it was usual in practice to state the size of the test bars. Often that size did not correspond in the cross section to the size of the casting itself. Under those conditions the casting and the test bar were not comparable. The

XUM

test bar should be comparable in thickness and in the condition in which it was cast to the particular castings in hand at the moment; he did not think the present specifications filled the bill for getting uniformity in results.

MR. T. G. HIRST said he spoke from experience of a small foundry, in which they made castings to specifications drawn up by their chemist. They had failures because they were dealing more or less with unknown quantities. One point that they watched was the silicon. Another was the coke. During the coal strike many ironfounders bought coke in which there was 2½ to 3 per cent. of sulphur, whereas 1 per cent. of sulphur should be the limit. Through using low sulphur coke, however, they sometimes had hard spots in semi-steel.

MR. S. E. EVANS said there was no doubt the problems presented to iron foundries varied considerably, with the diverse conditions. Much trouble was due to the price at which the work was expected to be done, because recourse was had to the scrap heap to an extent altogether incompatible with work which could be relied on. English irons were lacking in toughness compared with American irons, and nobody seemed to know why that was so. He had been told that the same phenomena was noticed in German iron. What was the tensile test as applied to cast iron? Did it really give any valuable information comparable with the information obtained from a bending test. For various classes of work irons could be modified so as to obtain the desired results, however different. The use of the electric furnace as an auxiliary to the cupola had recently been discussed. Important claims were made, as is usual in connection with specialised processes. Could Prof. Rhead give them any information on that subject? He would also like to know whether the percentage of manganese had any appreciable effect upon the strength of the cast iron. It had a similar effect to sulphur in tending to keep the carbon in combined form.

A Home-Made Cupola.

A firm which had two cupolas found they were far too large for the purpose in hand. Temporarily they fixed up on a simple bedplate a piece of old boiler flue, which was simply a melting pot. Instead of pouring into a ladle they allowed the iron to trickle into a shank and shanked it away to the moulds. One could scarcely imagine worse conditions, yet the foundry was turning out excellent castings. The wasters were kept within reasonable limits. The castings were of a special yet mixed character. The only trouble they had was with shrinkage cavities. What was the general feeling among foundrymen regarding the use of large cupolas against small cupolas? Did Prof. Rhead think the temperature at which the iron was run in the cupola had a great bearing upon the class of casting produced?

Wasters and Cupola Air Volume.

MR. DAWSON said he thought it was generally recognised that test-bars were only comparative and did not really show what was the strength of the metal in the casting. If they had two test bars and one was 15 tons and the other 10 tons, they knew there was better metal in the one than in the other. Really the test bars should be of the same section to make them comparable; with different sections one could not judge rightly as to the comparative strength of the metal. He thought the average percentage of wasters was between 5 and 7 per cent. Some time ago they had an experience of a breakdown of iron under compression. They found they could remove that trouble by either increasing the coke or reducing the volume of air blown in, so that the air per lb. of coke or per ton of metal was reduced. The trouble experienced in the machining shop from hard castings was also removed, and the percentage of wasters was much less; in fact, the curve showing the rejections came down from 18 to 2 per cent., exactly corresponding with the change in the amount of air per lb. of coke. The two curves were parallel.

The Importance of Cupola Practice.

MR. ROWE said the percentage of wasters depended upon the class of casting. If material such as firebars were being made it was easy to work within 2 per cent., but it was much more difficult where the testing was strict and every casting had to undergo a hydraulic test or the test bars had to show 15 or 16 tons per sq. in. For successful foundry practice the first essential was to have the cupola right. Very few foundries in this country had a gauge to show the volume of air which was delivered to the cupola. It was practically a *sine quâ non* in good cupola practice to have some means of measuring the actual volume of air supplied.

They found that the cast iron produced by electric furnace melting was much superior to cupola iron, and casting troubles were much reduced, but the high cost of electric power was against it. It had come into vogue in America because power was cheaper there. It was quite possible to get two views of practically the same analysis and the same appearance under the microscope, which would give different strengths in test bars.

It was often not wise to work to text-book figures as regards silicon and sulphur content with cast-iron, which might not be adaptable to the class of work it was used for. Such things as resistance to corrosion and porosity came into consideration. He had never been able to get good sound castings which would stand hydraulic pressure with anything like the silicon content recommended for strong iron. The best silicon content that he had found for metal intended to withstand hydraulic pressure was 2.2 per cent. to 2.5 per cent.

The sulphur bogey was always present with ironfounders, but it was far more marked now than in pre-war days. The proper procedure was not to allow the sulphur to exceed 0.1 per cent., but that was not possible when they were being asked to produce castings at about 21s. 6d. per cwt.

The Author's Reply.

PROF. RHEAD, in closing the discussion, said that for the average run of work 5 to 7 per cent. was a reasonable figure for wasters. But the question of the quality of the work was most important. Some years ago he had a case where solid castings were drilled up so as to get an internal cavity leaving only a ⅛-in. wall; they had to be perfectly oil-tight and capable of being machined to the utmost degree of smoothness, as smooth as a polished steel surface. Naturally the wasters ran much higher than in ordinary work. Initially the figure was about 33 per cent., but was afterwards reduced to 10 per cent.

The graphite flakes were very largely concerned with the determination of compression strength because the shearing effect took place in, or was influenced by, the direction of the flakes. The high tests that were obtained in certain cases after the introduction of sulphur within limits supported the theory that to retain the carbon in combined form or to leave the graphite in a very fine state of division, invariably increased the resistance to compression. Some years ago a foundry manager complained that he had failed three or four times to get the tests required in a specification for a particular kind of iron casting. He advised him to put some sulphur-bearing material in the cupola. The next week the manager reported that he was perfectly successful in producing metal to satisfy the specification; it was a mad specification, but the manager had to fulfil it, and he did so by putting sulphur into the casting. In the case of the piston rings mentioned by a speaker, the advantage obtained from using 0.2 per cent. of sulphur was due to the retention of more carbon in the combined form and the extremely fine graphite. Its effects invariably worked out on these lines. It must, however, be borne in mind that such metal usually held more dissolved gases.

There were many foundries now, and more in former days, which used cupolas of small size with only two tuyeres, two bustle pipes going in, one on each side. They worked perfectly well. Indeed, it was possible to melt iron perfectly in the crudest contrivances, under proper control by skilled men, but large output could not be maintained.

Open Hearth versus Cupola.

One of the most successful foundries in this country—certainly one that turned out work of the most uniform type—had abandoned cupolas

XUM

altogether and was melting in Siemens' regenerative furnaces. Waste had been considerably reduced, the quality of the work was good, and they would not replace those furnaces by cupolas. But such furnaces could only be adopted where a large and regular output was required. With regard to the electric furnace, the excellent results obtained with it were due partly to the change in the composition of the iron in melting. Usually there was a reduction in the proportion of silicon left in the iron after it had been melted in the electric furnace owing to the effect of the lime in the slag and the longer period of contact. The strength of the iron increased as a result of the smaller condition of the graphite.

MR. ROWE interposed that the silicon content in the casting from the electric furnace was 2.4 per cent. The carbon content was 2.8 per cent. against 3.3 per cent. in the cupola.

PROF. RHEAD said the difference of 0.5 per cent. of carbon would go to increase the size of the graphite flakes in the metal from the cupola and would account for the increased strength of the electric furnace metal.

Graphite had a great effect on the rapidity of corrosion. It formed channels by which the corroding influence entered the metal, passing along the side of the graphite flakes and actually corroding the metal internally as well as externally. Silicon control was a matter of the greatest importance. It determined the point at which the graphite commenced to separate, as well as the size to which the graphite flakes attained.

Chilled Castings.

The annealing of chilled wheels, or the temperature at which chilled wheels could be annealed, depended entirely upon the amount of silicon that the metal contained. The chill depended upon the carbon being entirely in the combined form. Graphite could begin to separate at 655 deg. C. with metal containing 1.25 per cent. of silicon, and it was possible to separate 80 per cent. of the combined carbon by annealing lasting only 8 hours. So the temperature at which the chill could be annealed was determined by the composition of the iron. With a higher proportion of silicon it was only necessary to heat iron for a shorter period in order to secure very extensive, almost complete, separation in the graphite form, as in softening castings for turning and machining.

The question of the depth of chill produced by hot chills lay on a somewhat different plane. The actual chilling depended entirely upon the solidifying and cooling effect and the formation of the solid skin extending into the solidification of the casting. If the chill were cold it was of a very dense form on the outside of the casting, and the depth of penetration was reduced, all constituents tending to lower the melting-point were urged inwards. This applied even to elements such as silicon, and the chilling effect was thus reduced. With a hot chill this was less pronounced; the formation of elongated crystals extended deeper into the casting; the conductivity of the solidified portion was greater, and a regular chilling, without change in the average composition of the metal, was effected to a greater depth.

Sulphur in Malleables.

To go back to the question of sulphur. In certain types of work—making Reaumur malleable castings, for example—invariably one used iron of high sulphur content. Two years ago they carried out an extensive series of experiments, and used metal containing over 1.4 per cent. of sulphur. In iron for making Reaumur castings sulphur was almost essential, the reason being that the decarburising of the metal did not take place when the carbon was in the graphitic form. It was necessary to retain it in the combined condition, and the sulphur effected this purpose.

The question of the toughness of foreign irons had been raised. Many of the American irons owed their extreme toughness to their purity, their freedom from sulphur and phosphorus. They were made from hematite iron ores, and corresponded with the hematite irons produced in this country. Foundrymen who were engaged in making extremely tough castings would know the value of hematite and non-phosphoric iron in securing that property. But that was not true of German irons. There it was only found in exceptional cases, when possibly there was present in the material some element which was not usually accounted for in ordinary analysis. The position corresponded very much to the position with English irons, which varied considerably in quality. The presence of certain elements not usually included in an ordinary analysis had a very considerable bearing. He had found, for example, aluminium, calcium, titanium, and the presence of such ingredients, even in small quantities, would produce marked differences in the properties of irons which otherwise appeared to be of the same character. Manganese also exercised a very marked effect.

The Position of Test-Bars.

With regard to the question of tests. They should be made under standard conditions on test bars run for comparative purposes separate from the castings to which they applied, to furnish a guide as to the quality of the iron which was being used. In scarcely any instance did they correspond to the actual strength of the metal in the casting, because that was affected to an enormous extent by the mass of the material and the conditions under which the casting was run. The question where test bar cast on should be put could be answered almost in a sentence. They must be placed in such a position as not affected unduly by the heat passing from the mass of the metal itself; it must be in such a position that it could fill with clean metal. In many cases it was advisable to cast a lump behind and beyond the test bar, so that a certain amount of metal would run through the test bar and clear away any dirt that might have been carried into it in the process of casting.

Silumin Metal.

At the German Motor Show one development was the use for hollow backaxle casings of cast aluminium alloy. The possibility of applying such alloys has been greatly enhanced by the invention of the aluminium-silicon alloy, called silumin, the properties of which show a considerable advancement as compared with aluminium alloys hitherto known. Owing to its softness, however, this alloy is not suitable for parts subject to heavy shock loads or intermittent strains. For such work, however, the parts have been strengthened in suitable places by steel bushings. This process has been facilitated inasmuch as the coefficient of expansion of silumin is smaller than that of other aluminium alloys. Besides complete back-axle casings for motor cars, differential casings made of this new alloy were exhibited, such as, for instance, in connection with the Maybach car.

(1) *Properties of Silumin.*

Type of Alloy.	German alloy.	American alloy.	Silumin.
Zinc .. .. (percent.)	10	—	—
Copper .. .. ,,	2	9	—
Silicon .. .. ,,	traces	traces	12—14
Specific gravity	2.9—2.95	2.9—2.95	2.85—2.9
Tensilestrength (tonspersq.in.)	9.5	7.6	12.7
Elasticity .. .. (per cent.)	2—4	1—2	5—10
Hardness at 18° C. ..	55	60	60
,, ,, 350 °C. ..	15—14	18—20	20—25
Coefficient of expansion ..	0.0000255	0.0000246	0.0000222

The Determination of Lead in Brass.

Thirteen grams of the metal are dissolved in HNO_3 (S.G. 1.2), and the excess of acid evaporated off by a porcelain dish; 40 ccs. of H_2SO_4 (S.G. 1.84) are added, and the whole is carefully evaporated to avoid spitting until sulphuric acid fumes start to be evolved. The whole is cooled and water is carefully added until the cake of copper sulphate is completely dissolved, the dilution being about 300 ccs. The precipitate is allowed to settle overnight. In the morning the $PbSO_4$ is filtered off through a double paper of "S.C. & C. 589" make, washed well with dilute H_2SO_4 and water and carefully dried and ignited.

Factor from $PbSO_4$ to Pb = 0.6832.

F. A. L.

Gas in the Foundry.*

By A. Docking.

(*Continued from page* 466.)

Systems of Gaseous Firing.

There are four distinct methods of applying gas and air when gaseous firing is used for industrial purposes. These are generally known as: (1) Low-pressure gas; (2) high-pressure gas; (3) gas and air blast; (4) gas and air mixture.

Low-Pressure Gas.—Ordinary coal gas is supplied at low pressure, and in this system it is used exactly as it leaves the town's mains. This, in many cases, is very uneconomical owing to the primary air having to be induced into the burner. The amount of induced air naturally depends upon the pressure of the gas, and, consequently, varies with it. Coal gas requires, approximately, five times its own volume of air, so that, unless the pressure be reasonably good, an insufficient amount is induced. The air thus added, however, does not intimately mix with the gas, so that, in order to provide sufficient oxygen for complete combustion, a considerable excess of air is required, the heating of which is a source of loss. Constant adjustment of both gas and air is required, consequently the control of the furnace is entirely in the hands of the operator. Economy with this system is, therefore, very difficult to obtain.

High-Pressure Gas. — High-pressure gas is another system which is sometimes employed, but this does not give satisfactory results. The mains and internal fittings have to withstand this excessive pressure (which is generally 3 to 12 lbs. to the sq. in.), and the amount of leakage taking place is a continual source of trouble. The cutting action of the gas, passing at a high velocity through a relatively small nipple, causes the latter to enlarge, thus upsetting the correct adjustment. In the high-pressure system, the nipple has to be renewed from time to time to keep the consumption approximately constant.

The difference in the density of the two gases, *id est*, air being 1, gas being 0.5, makes it impossible for them properly to diffuse or mix together in the limited space between the nipple and the burner nozzle, consequently imperfect combustion is the result. Could the stream of gas and air entering the furnace be seen, it would be found to consist of layers of gas and air alternately. This stratification cannot be avoided in the high-pressure system, with the result that a considerable portion of the gas passes through the combustion space in an unburnt condition, with subsequent combustion usually taking place in the flues.

Gas and Air Blast.—Another system is that of separate gas and air under pressure. Whilst this system gives a greater intensity of heat the control is, like the foregoing, also in the hands of the operator. The gas and air have little opportunity of intimately intermixing, and the gas consumption cannot even be approximately guaranteed, as if both gas and air cocks are not properly adjusted the consumption will be out of all proportion to the work done. The gas and air cocks require constant adjustment, as the town's pressure or the demand in other parts of the works affects each individual furnace.

Gas and Air Mixture.—The fourth system is that of intimately mixing together a definite quantity of gas and air in their correct theoretical proportions in accordance with the calorific value of the gas. Thus a definite mixture is always maintained even under fluctuating conditions of gas pressure and load on the service mains. The operator cannot change the gas and air proportions, which, when once set for perfect combustion, always remain fixed. It is impossible to get excess of either gas or air, hence waste fuel and oxidisation are avoided. The avoidance of excess gas or air is, however, practically impossible with the three systems already referred to. The system of definitely mixing gas and air is the only practical solution to the problem of gaseous firing.

The advantages claimed for the system are:—(1) The gas and air, once set to give a predetermined mixture and pressure, is automatically kept constant under all conditions; (2) it is independent of the town's pressure; (3) it is independent of the operator; (4) it gives greater ease of manipulation, together with a large saving in gas consumption; (5) it gives perfect combustion at all times; (6) uniform temperature is ensured.

* A Paper presented before the Coventry Branch of the Institution of British Foundrymen on November 16.

Gas and Air Incorporator.

Fig. 4 shows a special type of gas and air incorporator made in accordance with the Docking patents. Gas and air enter the mixing valve A

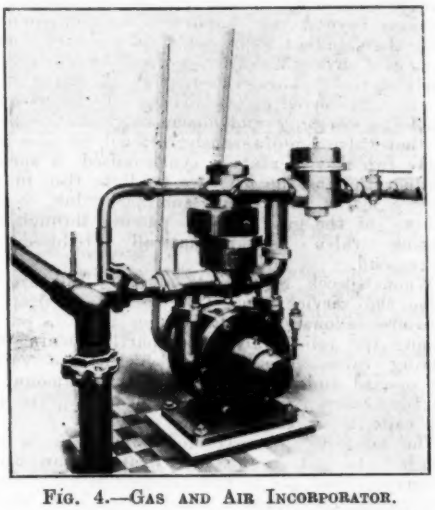


FIG. 4.—GAS AND AIR INCORPORATOR.

by means of separate passages, after which they pass along the passage B and so enter the mixing chamber C. Due to the action of the rotary fan D both gas and air are intimately mixed together, and are then discharged, under a slight pressure, through the delivery port E to the service mains.

In order to secure a mixture of gas and air at a predetermined proportion and pressure, it is necessary to ensure that gas and air enter the

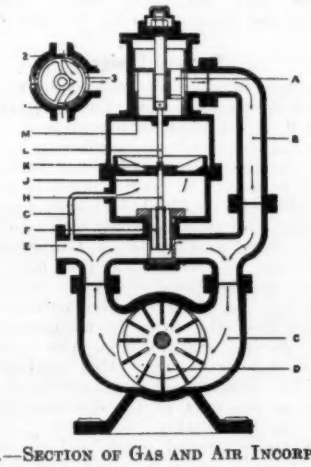


FIG. 5.—SECTION OF GAS AND AIR INCORPORATOR.

incorporator on equal terms. To attain this, air is taken direct from the atmosphere, while the pressure of the gas is reduced to neutral by passing it through a governing device.

Having reduced the gas to the same pressure as the incoming air, both are now allowed to pass into the mixing valve located at the top of the machine. Fig. 5 also shows a sectional plan of the mixing valve, and it will be seen that this consists of inner and outer sleeves, in which are cut three ports, 1, 2, and 3 for gas, air and mixture respectively. The suction set up by the machine induces gas and air through their respec-

XUM

tive ports, which are cut in such a manner as to allow of modification of their proportions by rotating the inner sleeve, according to the calorific value of the gas. This is indicated by a small test-burner fitted on the mixture outlet pipe. Ordinarily this adjustment is made by hand, but by fitting special temperature-control devices this regulation can be made automatic. The pressure at which the mixture is delivered is determined by the relief valve F, which is attached to diaphragm K by means of the spindle H. When the machine is started up the pressure rises in the service pipes E, and this pressure is communicated to the chamber J (by means of the pipe G), so that the diaphragm K is raised. This movement lifts the relief valve F, and allows the surplus mixture to pass back to the lower end to the delivery passage B. The end of the spindle H projects beyond the diaphragm K, and connects with the spindle L, upon which is mounted a mixing valve sleeve M. This ensures that each movement of the diaphragm actuating the relief valve is also transferred to the mixing valve, thus automatically covering and uncovering all the ports in that valve simultaneously. It will be seen that these two movements are synchronised in such a manner that as the pressure tends to rise, in the service mains, above its normal value, so the volume of the gas and air passing through the mixing valve is automatically reduced to correspond.

When a cock is opened, allowing mixture to leave the service pipe, the momentary drop in pressure allows the diaphragm to fall, partly closing the relief valve, and partly opening the mixing valve. The amount which these valves are opened and closed depends on the amount of mixture taken from the service pipe, up to the full capacity of the machine.

The machine is constructed so that it is impossible to get a mixture weaker than three volumes of coal gas to two volumes of air. Since coal gas is not explosive when mixed with air in this proportion, the mixture delivered is perfectly safe. When lower-grade gases are used the machine is adjusted by the makers to ensure a non-explosive mixture, thus rendering the system absolutely fool-proof in the hand of the most careless operator.

This system is now in use for all classes of industrial heating: Heat treatment of metals. drying of cores, tube manufacture, brazing, and similar work. The same incorporator will supply a mixture which is suitable for high-speed steel furnaces, carbonising and re-heating furnaces, lead pots and cosletising baths, temperatures being obtained from 1,500 to 100 deg. C.

Furnace Designs.

The supply of fuel in gaseous firing is under such perfect control that temperatures can be maintained by the expenditure of just the amount of B.Th.U.s required to perform the requisite heating. In the case of solid fuel furnaces, however, it is necessary to burn a much larger amount of fuel than is required for heating the work and furnace, the surplus going to waste merely in order to secure uniformity of temperature. The feeding of the fire with fresh fuel must of necessity reduce the temperature of the furnace, hence the need for providing for the maintenance of a fire so hot that the drop in temperature resulting from stoking will not bring the furnace below the required temperature. This method is wasteful, besides demanding constant and watchful attention on the part of the operator in order to maintain a reasonably constant temperature. The work to be heated must be kept far enough from the fires in order to avoid damage from the products of combustion. This consideration demands, in many cases, complete isolation of the work in muffles or chambers. This system is extravagant, because the whole of the brickwork containing the fire, together with the brickwork of muffles and flues, must be raised to a considerably higher temperature than the work demands before the work itself can reach its required temperature. It is quite true that many gas-fired furnaces are built on these lines, in order to exclude the products of combustion, although in these cases the gas flame is allowed to impinge directly on to the walls of the muffles, which is a distinct advantage over the solid fuel fire. It should be noted that with such work as re-heating, annealing of brass, etc., carried out in a chamber in which open gas flames are burning, come to no harm from products of combustion when the ovens are operated under a system which ensures perfect combustion. The evils which usually accrue from an excess of oxygen cannot exist if the gas is supplied mixed with exactly the correct amount of oxygen needed for combustion and no more. The products of combustion are carbon dioxide and water, and if the gas used is reasonably clean neither of these can do harm to steel or brass. In any case, they are less harmful than oxygen, which is always present in a muffle chamber.

In all furnaces the heating of the brickwork is a considerable source of loss. It should be borne in mind that every cubic foot of brickwork which has to be raised to 1,000 deg. C. requires 0.42 pence worth of coal gas (at 4s. 2d. per 1,000 cu. ft.). This obviously points to the necessity of keeping the heating chamber as small as possible, consistent with the size of the work to be heated.

Having found that metal burners quickly wear away, thus necessitating pulling down of

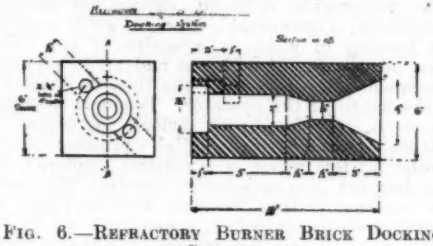


FIG. 6.—REFRACTORY BURNER BRICK DOCKING SYSTEM.

the firebrick lining at frequent intervals, a carborundum burner has been designed, which obviates this necessity. Carborundum will stand a temperature of 2,200 deg. C., and has a tensile strength four times that of firebrick, so that this burner will outlast the lives of several firebrick linings. This is illustrated in Fig. 6.

Table 2 shows the manner in which the heat units are distributed in a melting furnace, using gas and electricity respectively, and compares their costs. It will be seen that out of a total of 1,575,000 B.Th.U.s, 842,000 are used for heating up the brickwork, 32,000 are lost through

TABLE 2.—*Showing Comparison of Heating Cost Using Gas and Electricity.*

	Gas. B.Th.Us	Electricity. B.Th.Us.
Heating Metal	380,000	380,000
Latent Heat	40,000	40,000
Radiation Losses	32,000	—
Heating Pot	16,000	—
Flue Gases	265,000	—
Heating Brickwork ...	842,000	842,000
	1,575,000	1,262,000

The use of electric furnace (assuming no radiation losses) would save 213,000 B.Th.Us.

COST.

1,575,000 B.Th.Us. in gas cost 14s. (with gas at 4s. per 1,000 cub. ft.)

1,262,000 B.Th.Us. in electricity cost 370 kw. at 1½d. per kw.=46s. 3d.

From this will be seen that on this type of furnace electrical energy must be procurable at .455d. per kw. if it is to be used as a substitute for town's gas.

radiation, whilst the waste gases carry away 265,000 B.Th.U.s. Thus the actual heating of the metal only requires 26.7 of the whole, so that in order to increase the efficiency of this plant the B.Th.U.s required for heating the brickwork must be considerably reduced, whilst the waste gases should be utilised. The former implies that better refractories are required. Experiments are being made in this direction by making special refractory bricks of a porous nature, so as to reduce their heat-conducting properties, whilst they are faced with a carborundum mixture so as to present a hard surface.

Pre-Heating.

Considerable economy may be effected by pre-heating the work, which may be carried out in a separate chamber heated by waste gases, or in a salt bath (if oxidisation is to be avoided). In some furnaces arrangements are made to pre-heat the incoming air by passing it through a previously heated passage. This system results in a gradually rising temperature, because as the air gets hotter so will the furnace temperature increase. If this arrangement is to work successfully it must be provided with some means of temperature control, and herein lies a serious difficulty when operating with separate gas and air owing to their varying densities. Gas and

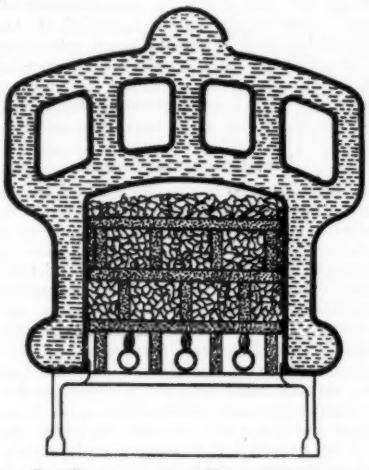


FIG. 7.—SECTION OF A BOILER ADAPTED FOR GASEOUS FIRING.

air mixture can, however, be satisfactorily pre-heated, as thermostatic control modifies the supply of both at the same time, and, since both gas and air are delivered by the incorporator correctly proportioned, it does not matter to what temperature they are raised, providing this is below the temperature of combustion, the proportions, in all cases, remaining constant and accurate.

Fig. 7 illustrates the application of gaseous firing to an ordinary section-boiler for the heating of works and offices. It will be seen that the bed of fuel has been replaced by layers of fire brick. A series of gas burners provided with nickel gauze nozzles are placed underneath. By this system of firing the temperature can be easily regulated, and practically no labour is required.

Heated air is frequently used for drying purposes, the air being made to pass round a series of steam-heated tubes, after which it passes on

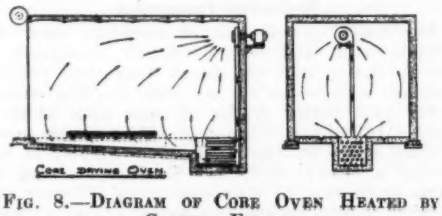


FIG. 8.—DIAGRAM OF CORE OVEN HEATED BY GASEOUS FIRING.

to the work to which it is required to dry. The use of steam for this purpose is most economical, owing to the condensation and other heat losses between the boiler and the apparatus. When gaseous firing is used, heat losses are practically eliminated, as not only can the heating chamber be placed inside the drying machine, but even the heat of the products of combustion can be utilised.

In engineering works during the afternoon large coke fires are made up for heating the core ovens, after which the cores are run in, and the doors sealed. The fires are usually kept in throughout the night, and the cores withdrawn the following morning. This method is both crude and wasteful. In the first place, the fuel is not burnt economically, practically no secondary air being available. Furthermore, the moisture in the cores is retained in the oven, whilst the air, instead of being in circulation, is practically stationary. Owing to lack of circulation the water vapour, generated by the heat, remains on the surface of the cores. This vapour is, however, a bad conductor of heat, thereby hindering the drying process. It is well known that wet clothes, hanging out in a good wind, will dry rapidly, even if the temperature of the atmosphere is low. In

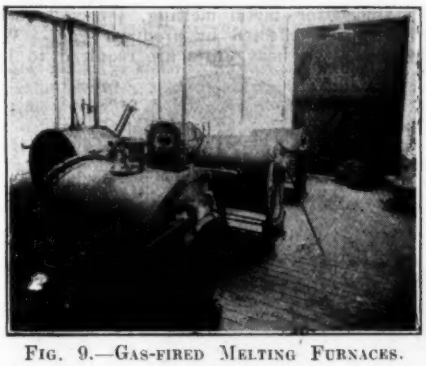


FIG. 9.—GAS-FIRED MELTING FURNACES.

the same way, a little warm air on the move is far more effective than a large quantity of stationary air, even though the latter be at a high temperature.

Fig. 8 shows a core oven heated by gaseous firing. A motor-driven fan draws air from the oven and forces it down a vertical pipe and so through the tubes of the gas furnace. It is then re-distributed throughout the core oven by means

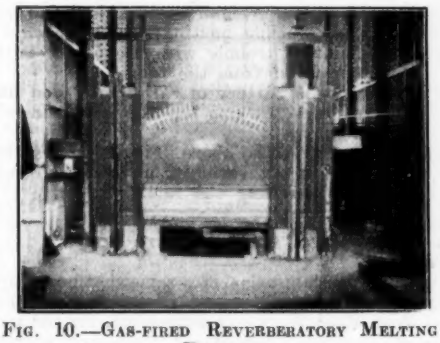


FIG. 10.—GAS-FIRED REVERBERATORY MELTING FURNACE.

of a central duct, and is thus kept in constant circulation. It will be seen that, apart from radiation losses, the whole of the heat put into the chamber remains inside the oven. The author recently investigated some large core ovens of the old type, and found that the thermal efficiency was under 5 per cent. The thermal efficiency of the arrangement shown in Fig. 8 is, however, within the neighbourhood of 55 per cent.

FIG. 11.—VIEW OF A BATTERY OF CARBURISING AND NORMALISING FURNACES.

The type of furnace recommended for the melting of metals, such as nickel alloys, malleable iron, gunmetal, aluminium, and white-metal alloys, varies with the normal quantity required per heat. Thus for small weights, say 80 to 100 lbs., a crucible type of pot furnace is recommended which requires 3 to 4 cub. ft. of coal gas per 1 lb. of gunmetal melted at a cost of 5d. to 6d. per 100

lbs. When, however, the heats average about 300 lbs. and upwards, a reverberatory type is recommended which requires 2 to 2½ cub. ft. of coal gas per 1 lb. of gunmetal melted at a cost of 3d. to 4d. per 100 lbs. Figs. 9 and 10 show respectively a battery of gas-fired melting furnaces and a gas-fired reverberatory furnace, the latter being the most economical of all systems for metal melting, especially when the heating is effected by producer gas. With the former type heat units are required to heat

FIG. 12.—COAL-FIRING CARBURISING FURNACES.

up the pot which, unfortunately, is a poor conductor of heat. Furthermore, the average life of a pot is only about 36 heats. With the reverberatory type the flame impinges directly on to the metal, whilst radiant heat is reflected from the walls of the furnace. In addition, the reverberatory type can be bottom tapped, so that only clean metal comes out, the scum and oxide being left behind. With crucible melting there is always a certain amount of trouble with the oxide, owing to its being poured from the top.

Fig. 11 shows a battery of carburising and normalising furnaces working on the gas- and air-mixing system.

In contrast with the above, Fig. 12 shows that for the firing of six furnaces no less than four men are seen handling the fuel.

Export of German Wire Ropes.

An export organisation of a somewhat novel kind is proposed by the Economic Association of German Wire Rope Works, of Düsseldorf, for the purpose of promoting the export trade and thereby enabling Germany to obtain foreign currency to pay her indemnity with. The scheme proposes in the first place that German works obtaining an order from abroad shall receive a commission of 5 per cent. on the order in the currency of the country for which it has been booked. In addition to this, the works in question is to be allowed to book one-fourth of the order without this quantity being deducted from its allocation in the Association, and, of course, also one-fourth of the amount of the invoice. The remaining three-quarters of the order are to be divided among the constituents in such a way that 75 per cent. of the three-quarters are distributed among all the constituents of the Association in proportion to the number of workmen employed by the various concerns at the end of 1919, while the balance of 25 per cent. is to be divided among all the works in equal shares irrespective of the size of the different plants. It is claimed that this scheme would render it possible for 70 per cent. of the amount of the bills of exchange obtained through foreign orders to be placed at the disposal of the Government, and mutual underselling of the various concerns abroad would be stopped.

It is explained that the situation of the German wire rope industry has hitherto been of such a character that export prices were reduced to the level of inland prices. Under the pressure of the competition of German non-associated firms, the members of the Association, who until then had faithfully observed the rule to sell only in foreign currency for export, were compelled to drop their allegiance to the Association since last March, and to invoice their goods in marks. Under the proposed scheme, however, as almost all the makers of wire ropes have now joined the Association, it is calculated it will be possible to sell in foreign currency in every case and obtain substantially higher prices abroad.

Reclaiming Moulding Sand.

This subject was discussed in a recent issue of the "Iron Age," the writer prefacing his remarks by stating that the disposal of old moulding sand is often one of the most serious problems confronting a foundry. Where space is not available for dumping, the removal of used sand often involves considerable expense. In some cases this difficulty has been overcome by reclaiming the sand and using it again in moulds. Successful reclamation, however, demands careful study of the physical properties of the sand, the added elements and the process required to make it suitable for re-use and other considerations. Investigations by H. M. Lane in the Detroit district indicated what might be accomplished both by washing and dry cleaning old sand, while research by H. B. Hanley and R. F. Harrington showed results which might be achieved by adding clay or a new sand with an unusually heavy bond to provide the bond for used moulding sand.

Joint Committee Formed.

Believing that much can be gained by investigating the subject of moulding sand with the end in view of arriving at standard methods of testing moulding sand and classifying it into grades according to its bond, refractory qualities, permeability, fineness, etc., a joint committee of the American Foundrymen's Association and the engineering division, the American National Research Council has been formed.

To ascertain the sentiment of the foundry industry on the work which has been undertaken and to secure the maximum of co-operative effort, a series of meetings will be held at which the subject will be presented to local foundrymen's associations. The first of these was a meeting of the Chicago Foundrymen's Club at Chicago on November 12, which was addressed by Mr. R. E. Kennedy, assistant secretary of the American Foundrymen's Association and also secretary of the joint committee of that body and the engineering division of the National Research Council. Mr. Kennedy pointed out that the State of Illinois was ready to make a survey of the sand of the State, but could not proceed because there are no standard tests for sands and no recognised methods of grading them. Physical analysis, he asserted, was more important than ascertaining the chemical properties of moulding sand, as sands with same chemical analysis would give widely different results in moulding work. He described some of the physical tests used, but pointed out that there are differences of opinion as to their value. The matter of keeping costs of sand used for moulding is alone worthy of consideration—something which has been too often ignored by foundries.

Mechanical Preparation.

Mechanical preparation of moulding sand, the speaker said, had been developed intensively by the Germans, with the result that they produce castings with better surface than the English who have much better grades of sand with which to work. Intelligent mixing of old and new sands, or clay, offers an opportunity for economy as well as for a better product. Sands containing the same proportion of clay may have different properties, because in the one case the clay is plastic and in the other it is not. In England sand is available which contains considerable iron hydroxide which increases its bonding characteristics, and to this sand is attributed the superior finish on the British steel castings. Investigation which would result in ascertaining how to prepare a synthetic moulding sand containing some desirable qualities would be invaluable. tain research shows that the addition of 4 per cent. water to a certain moulding sand gives the best results; yet a sand may hold much more moisture than the amount at which it is best for use and test of the sands used by the best moulders indicate wide variations in moisture content owing to their dependence on the sense of touch to determine the proper degree of wetness.

A FIRE BROKE OUT at Messrs. Richard Thomas & Company's mills at Lydney, Glos., but the damage was not heavy.

Institution of British Foundrymen.

BIRMINGHAM BRANCH.

Discussion on Mr. Wilkinson's Paper on "Electric Furnaces in the Foundry."*

THE CHAIRMAN said in Birmingham they were very unfortunately placed with regard to electric furnaces, as there were not many in operation, and it was not an easy matter for those interested to see them. In Sheffield, however, and other towns they were much more numerous, and doubtless in those areas their members would be more familiar with their practical working.

Decarburisation by Ferric or Magnetic Oxides.

PROF. TURNER, in proposing a vote of thanks to Mr. Wilkinson for his Paper, said Mr. Wilkinson had given them the reactions that took place in the furnace and more particularly in reference to the melting of steel. There was only one little suggestion he would make. Mr. Wilkinson stated that the two reactions—the reaction with ferric oxide and ferrous oxide—both went on together. That was perfectly true. The ferrous oxide did not melt without decomposition and ferrous oxide was unknown to them as a pure substance. What happened was that the ferric oxide and ferrous oxide combined together to form a fluid magnetic oxide which was the active agent, and if they examined the slag under the microscope they saw this magnetic oxide which had been in solution thrown out in its characteristic crystalline form. In explaining what went on in the furnace he generally combined these two reactions, instead of putting them separately, and worked out what occurred on the basis of magnetic oxide. It recalled what was quite an active discussion of some 25 or 30 years ago, the question being what was the agent which led to oxidation in the puddling furnace or in the steel furnace, and as to whether it was really ferric oxide or magnetic.

The Choice of a Furnace.

In connection with the introduction of electric furnaces, the author had well said that the conditions under which the current could be obtained often determined the furnace to be employed. Where they were dependent, as they were in the Midlands, upon supplies of electricity which were designed for other purposes primarily they met with difficulty. He questioned whether the Birmingham Electricity Committee would be prepared at the present moment, or whether they had the necessary machinery and the necessary power available to provide current for metallurgical purposes on anything like a large scale. They remembered, for instance, in Sheffield what tremendous developments were necessary to meet requirements during the war. He was informed that a furnace was recently purchased and brought into the Birmingham district—a furnace of the type to which Mr. Wilkinson had referred—for the melting of non-ferrous alloys. Single-phase current was required, and difficulty was met with on account of the interference with the general electric system of using furnaces of the size of the one in question, taking a ton charge. The result was that the furnace had not been used. There might be other reasons connected with the state of trade and so forth, but, at any rate, that was the reason given to him. The purchase of an electric furnace where they had not a supply of electricity guaranteed and ready at hand was a very small part of the total expense in many cases. At the present time he had small and large types of furnaces—he meant large for the laboratory, though very small in comparison with the furnaces of which Mr. Wilkinson was speaking—ten or a dozen of them, and every one of them wanted either a different kind of current or a different quantity of current. For some he required a direct current, while in others he required an alternating current.

He began with a voltage of something over two, such as was used for aluminium decomposition. Another furnace required a voltage of about 20 to 25, while for iron and steel he needed, say, 75 up to 150, according to the circumstances. The result was that in his case he required to tap off from one source of supply all these different voltages.

* See Page 442.

Non-Ferrous Electric Furnaces.

For the non-ferrous trades in the Birmingham district there was an enormous possibility in the direction of electric melting. In America he understood that the largest works at the present time had practically given up coke melting, and he believed he was correct in saying that over 400 electric furnaces were employed in connection with the non-ferrous metal industry, many of them melting a ton at a time or more, in the U.S.A. and Canada. It was not merely the cost of electricity here, though that was, of course, an important point. But speaking not as an electrical engineer but as a metallurgist it appeared to him that for manufacturing purposes what they required was a definite supply of electricity suitable for their purpose and more or less devoted to that purpose if they were going to carry on a large metallurgical industry dependent upon electric melting. There were several furnaces working in the Birmingham district at present, but his anticipation was that in future, and in the not very distant future, there would be a very large increase in the amount of electric melting, not only in the iron and steel trades, but also in the non-ferrous industries. There had been a distinct set-back, of course, since the war. During the war expense was comparatively of little account, and there was a great demand, but a number of furnaces that were working during the war had closed down not merely because many branches of the metal industries were almost at a standstill, but because at the close of the war a number of furnaces would have been closed down even under normal conditions because they were not economical. When, however, one saw how flexible and adaptable electric current was under suitable conditions, and how losses were diminished and quality improved, one could not but feel that there was a great future for electric melting in various directions. He saw a photograph the other day of an installation by Keller for the synthetic production of cast iron, showing a long row of electric furnaces used for this purpose, and it was an extremely impressive picture. Those furnaces, like others of which he had spoken in our own country, he believed were not at work at present because the special necessity for them had passed.

MR. H. L. REASON, in seconding the motion, said he could corroborate Prof. Turner's statement that an electric furnace in Birmingham could not be used owing to difficulties regarding the supply of current. He agreed with Prof. Turner that if the non-ferrous industry was going to abandon the present method of melting and take up electric melting special arrangements would have to be made for the supply of current. If suitable current could be supplied for melting economically non-ferrous metals by electricity on a commercial basis progress would be made, because when melting metals in cupolas or open furnaces all sorts of troubles were met, and after blaming everyone attached to the foundry it was finally found to be the method of melting which was responsible. There was no question that electric melting was the correct method. Mr. Wilkinson had established that the results obtained from electrically-melted metal were far superior to metal melted in a cupola and the same remark applied to the non-ferrous trade.

The vote of thanks was warmly accorded to Mr. Wilkinson.

Scientific Control.

MR. E. N. WRIGHT said that the cupola was altogether too little under control for making the best of ironfounding. Part of the success of the electric furnace was no doubt due to the scientific control, and it was up to them as foundrymen to apply the same care to the use of the plant that they already possessed. He had not the slightest doubt that the product of their cupolas could be very much improved by the application of more scientific control. The cupola was a dust and smell-emitting contrivance, which they generally placed as far from themselves and their office windows as they possibly could, and it obviously was in a position in which it was very often neglected. If the cupola man turned up to his work regularly and nothing very terrible happened he

XUM

was afraid he was very often left to carry on as best he could. That was not right, and one lesson to be derived from the Paper was that if they could not have electric furnaces they could at least make better use of the furnaces already installed.

MR. F. HOLBERRY asked the lecturer if direct castings could be made in electric furnaces from the ore. If that was so there were vast possibilities ahead of the electric furnace in the cast-iron industry. Mr. Wilkinson also mentioned the melting of steel turnings in conjunction with small coke in an electric furnace, and he would like to know what would be the result if cast-iron turnings were melted in the same manner.

Electric Furnaces for Roll Making.

MR. ARTHUR PARSONS said the lecturer spoke of initially charging one ton in an electric furnace which was melted and supplemented by two tons from the cupola. Supposing they were required to fill a ladle holding ten tons? The lecturer, he understood, said the heat would be sufficient to allow of waiting until the next two tons came along, which would be practically fifteen minutes, and so on until the quantity of ten tons for the roll was obtained. Before casting a chilled roll it was very necessary to take a sample for ascertaining the chill. This took a considerable time to cool before it was ready to break in such a manner as to give an opportunity of judging the chill. He asked Mr. Wilkinson if there would be sufficient time, after filling the ten-ton ladle in the manner he suggested, and then have half an hour to get the sample broken? If the metal would remain fluid enough for casting a roll after that half-hour had expired, he thought that the electric furnace, in conjunction with the cupola, was a proposition well worth trying for roll makers.

THE CHAIRMAN asked the author to give power consumption which would apply to the refining of cast-iron under the duplex process. The general consensus of opinion was that the electric furnace was unlikely to replace the cupola and air furnace as a melting unit, but as a refining medium it was a valuable adjunct. His own estimate was between 200 or 250 kw.-hours per ton would be required for the refining process. The lecturer's closing remarks with regard to malleable iron were interesting, because they opened up a large field in the direction of making black-heart malleable, it being impossible to keep the sulphur sufficiently low in cupola melting. The few people who were making it at the present time in this country were making it not from the cupola but from the air furnace. Apparently black-heart malleable iron was a metal which in the very near future would be more popular in this country very largely on account of the successes which the Americans were able to show with that material. Those who had seen recently the amazing reports from the American research departments and the figures given could have no doubt, whatever engineers might say, that black-heart malleable castings were equal to the European material. The electric furnace was not only able to melt metal without any addition of sulphur, but it gave them an opportunity of decreasing it where that might be necessary. A point on which Mr. Wilkinson might have laid more emphasis was the extra fluidity given to the metal. The electric furnace gave them an opportunity of heating to any extent, but they had under control, simply by the adjustment of the amperage, the possibility of raising the metal to practically any desired degree above the melting point. They had not that advantage by any other means, and that was a most valuable quality of the electric furnace in the case of cast iron.

The Author's Reply.

Replying upon the discussion, MR. WILKINSON admitted that the electric furnaceman did have tribulations, especially in his early days. If all the expense could be cut out, or if expense was no object, he had no doubt that in less than ten years there would not be a melting furnace of any description save electric furnaces in the whole world. The difficulties were easily overcome by intelligent application, and there was no questioning the ease of operation. When the metal was melted electrically, difficulties still existed. There was a new set of characteristics to be learnt before the best way of handling the metal was ascertained in order to secure sound castings. Electrically-melted steel did not always set and cool along the same lines as steel melted in either the open-hearth or converter. Unless extreme care was taken electric steel was much more liable to cracking on account of its excellent quality. As to the cost of non-ferrous melting, he was of opinion, on the whole, that it would be cheaper to melt in an electric furnace than in a crucible furnace. The efficiency of a properly designed furnace used for non-ferrous alloys would be about 80 per cent. The losses judged by the published figures would be not more than 2 per cent., and taking into consideration the control over the metal and the entire absence of draught—the melting all being done in a closed chamber—it would be realised that a very much lower melting loss would be experienced. Even with current round about 1d. a unit, he was of the opinion that it would be cheaper to melt brass in an electric furnace than in a crucible. The actual handling could be entrusted to a man who would use his intelligence. As to whether segregation would occur one could hardly say short of testing the matter. On the question of size, he said electric steel furnaces handling a 30-ton charge were not exactly common, but there were ten or a dozen in the world at present, and there would be no difficulty at all in designing a furnace to melt 30, 40, or even 50 tons of cast iron. As to the use of cast-iron turnings, he did not know any reason at all why they should not be used.

In reply to the Chairman's question, he expressed the opinion that a furnace run on the lines he indicated would not consume more than 95 to 100 kw.-hours per ton for refining—150 kw. per ton would be an outside figure. In many places troubles were experienced with grey-iron castings, which would be entirely avoided if electrically-prepared metal were used. Motor car cylinders would be very much better made from electric cast iron than ordinary cupola metal. Referring to black-heart malleable iron, he remarked that ordinary British irons treated in the furnace would have the sulphur reduced to such an extent that there would not be the slightest difficulty in getting black-heart material, and they would obtain a metal superior to the average metal produced in America. In the malleable iron industry the electric furnace would have a much better opening than in the cast-iron industry. Light steel castings were comparatively dear, and malleable iron could be made that would give results approaching 75 per cent. of the results obtained by steel casting, both in tensile strength and elongation, and, moreover, it could be produced at a price so much below that of steel castings that there would be no difficulty in finding a market for it.

NEWCASTLE BRANCH.

At a general meeting held in the Neville Hall, Newcastle, October 29, the chair was occupied by Mr. W. J. Paulin. The annual report was adopted, on the motion of Mr. M. Gallon, seconded by Mr. Matthews.

The following officers were elected:—Mr. R. O. Patterson, president; Mr. H. J. Young, senior vice-president; Mr. S. W. Wise, junior vice-president; and Messrs. M. B. Herbst, J. D. Carmichael, J. W. Frier, and H. J. Young were elected to fill vacancies on the Council.

MR. PAULIN, in proposing the re-election of Mr. H. A. J. Rang as secretary, said it would be impossible to have a more efficient officer than Mr. Rang. Mr. Smith, in seconding, said that it was generally admitted that Mr. Rang was one of the best secretaries connected with the Institution.

The motion was carried by acclamation, and Mr. Rang suitably replied.

THE BRANCH-PRESIDENT, in proposing a vote of thanks to Mr. Vardy, the retiring president, said he believed a record had been created during Mr. Vardy's tenure of the chair in more ways than one, and it had largely been due to his kindness and to his personality that that desirable result had been brought about. Mr. Carmichael seconded, and the vote was carried by acclamation.

MR. PAULIN, replying on behalf of Mr. Vardy, who was unable to be present, owing to illness, said he had taken a very deep interest in the affairs of the Institution, and he had felt highly complimented at the numbers they had had at the meetings.

A special vote of thanks was also passed to Mr. Rang for his services as secretary.

THE PRESIDENTIAL ADDRESS.

THE PRESIDENT then delivered his presidential address, in the course of which he said :—

Gentlemen,—The foundry trade to-day is undoubtedly passing through the worst phase in its whole history. Never in the memory of man has business been so scarce as at present. It would appear that we were experiencing another strike, i.e., the strike of the buyer who will not pay the present-day price of castings, the result being very nearly a total cessation of orders. This state of affairs has always happened in past years after wars, and is, in this case of such huge dimensions, in direct proportion to the size of the late war. The position has been seriously affected also by strikes both in our own trade and in the coal industry.

The false state of prosperity during and immediately after the war led all of us to believe that this comfortable state of affairs was going to be continued indefinitely. However, the pressing needs of the world have been satisfied, and orders irrespective of price are a thing of the past, so that the sooner we buckle to and get back to normal output and cost, the better for everyone concerned. This will be a matter of time.

One cannot expect a great world upheaval, such as the war, to go past without leaving its mark behind. Exchanges have been thrown into a state of chaos, so that the question of export is nearly an impossibility, and, with our export trade gone, we are in a very parlous state. It therefore behoves every man to put his best foot forward to try and bring things back to a reasonable state. Undoubtedly prices must be still further reduced, output per man must be increased, and every possible means must be used to endeavour to cheapen the finished article.

Improvement in Foundry Practice.

In the foundry, I think that there are many directions in which improvements can be made. One of the most important ones is in the direction of getting castings standardised, so that a serious attempt could be made to introduce machine moulding into our district. The apathy of the users of castings towards standardisation is very difficult to understand, but it is largely due to the insane cut-throat competition between founders which obtained before the war, resulting in castings being sold at considerably less than their true worth. To-day, with higher labour and material costs, these users of special castings cannot afford the price, the result being the present state of affairs.

If we take the example of street castings, such as manholes, etc. Every surveyor, whether of a large city or of a country village, has his own pet ideas as to how a manhole should be made, instead of discussing the matter in their Institution and agreeing to a standard so that the founder could quite safely spend an adequate sum in making first-class patterns and box parts, thus helping to produce the articles at a cheaper rate. Now this state of affairs obtains in a more or less degree throughout the whole of the British engineering trade, and I only hope that this part of the lesson of the present slump will be taken to heart. I am glad to see that the President of the Institution of Automobile Engineers took up this question of industrial standardisation very thoroughly in his opening address a few days ago, and I hope therefore that some progress in the right direction may be the result.

Another field in which there are large possibilities for economies is in the direction of scientific research.

The British Cast-Iron Research Association.

As most of you are aware, the British Cast Iron Research Association has been formed during the past twelve months which, in my opinion, is one of the greatest advances the foundry industry has ever taken. The lists of the problems which have been handled by the Director of Research, and which appear monthly in THE FOUNDRY TRADE JOURNAL, give you some idea of the work going on. These problems have been submitted by firms who are members of the Association, and the results are only supplied to members.

Now, Gentlemen, I think that you will agree that these problems constitute a very interesting programme of vital importance to every foundryman. Yet the apathy shown generally, and particularly on the north-east coast, can only be described as appalling. Out of all the foundries in our neighbourhood only some twelve to fifteen have become members. Now the Association cannot exist without the full support of the foundry trade, and I appeal to each of you not to rest until your firm has become a member.

With regard to the programme of the B.C.I.R.A., I think that the subjects appertaining to the cupola are of great interest and offer a very large field for economies in the foundry, for even with the best-known practice there is a wide margin before anything like 100 per cent. efficiency is gained.

Apprenticeship Training.

Another subject which is indirectly connected with foundry economies is the education of foundry apprentices. This subject has been discussed by your Council and an attempt has been made to get classes instituted by the educational authorities, but I regret to say that so far we have been unable to make headway, apparently owing to our ignorance on the subject of red-tape pulling. However, we have not yet given up hope, and trust that before long we shall win some measure of success. On the other hand, it is quite possible that anything done in this direction will have to be done by ourselves. In this case it would appear that each foundry or a group of a few foundries would have to provide a fair-sized room to be used generally by the men for recreation purposes and on occasions for a lecture. The lecturers would have to be provided by this Institute, and if the subjects were arranged in some sort of order, I have great hopes that a very large amount of spade work would be accomplished. I am quite sure that foundry boys and young men have only to be started along the right path, and in a short time an immense amount of enthusiasm would be aroused.

It is very evident to me that the abominable feeling of hostility which exists to-day between employer and employee is largely due to the lack of interest taken by the men in their work and also the "up against a stone wall" feeling which is bound to exist when a man only knows the alphabet of his job. By this I mean that it must be very discouraging to an intelligent man to make castings day after day and to know no more about his business than to ram the sand around the pattern.

If that man knew enough about iron so as to form an intelligent opinion as to the cause of a faulty casting he would certainly have a greater interest in his work. As things obtain to-day, all he can say is that the metal is bad! As to how or why it is bad he knows nothing.

Another view of this hostility leads one to think that it is the return swing of the pendulum from the bad old pre-war days.

Now I think that if there was a works recreation room where employers could sit and talk to the men, smoke with them, and talk over foundry problems of everyday interest, it would be largely responsible in bringing around that feeling of confidence between both parties which is so greatly to be desired.

Now the foregoing is only an idea, and so far as I know has not yet been put into practice, and it may possibly contain some disagreeable features, but a start with this problem has got to be made, and in my opinion the sooner the better.

There is one item of interest which I should like you to know, and that is that I expect my friend Mr. David McLain, of Milwaukee, to visit this country in the near future, and I fully expect him to give a Paper on semi-steel. It will have to be a special night, but I expect to see a record attendance here in view of the absorbing interest of the subject.

NOTES FROM THE BRANCHES.

Birmingham Branch.

The annual dinner will take place at the Imperial Hotel, Birmingham, on Saturday, January 21. Chair to be taken at 6 p.m. by H. Field, Esq., Birmingham. Mr. Oliver Stubbs (President of the Institution), Mr. C. Retallack (Chairman of Willenhall and District Ironfounders' Association), Mr. H. B. Weekes, F.I.C. (Barrow), Chairman of Council, British Cast-Iron Research Association, have definitely promised to be present.

Trade Talk.

THE Hodbarrow Mines, Millom, have been closed till further notice.

THE INTERNATIONAL NICKEL COMPANY have closed their offices in Canada.

K. ETTLINGER & COMPANY have removed to 44/6, Leadenhall Street, E.C.2.

THE ALLIED MACHINERY COMPANY, LIMITED, have removed to 70, Victoria Street, London, S.W.1.

CLAYTON WAGONS, LIMITED, are supplying twenty 40-ton bogie wagons to the London and South-Western Railway.

HENRY HOPE & SONS, LIMITED, of Birmingham, are supplying the steel windows for the new General Post Office in Buenos Aires.

MR. H. HOBSON has established himself in business at 105, Queen Street, Sheffield, under the style of the Consolidated Steel Company.

ROBERT JENKINS & COMPANY, LIMITED, of Rotherham, have appointed Mr. N. Anton, 87, Union Street, Glasgow, as their agent for Scotland.

THE LONDON METAL EXCHANGE will be closed after the meeting on December 23, till Wednesday, December 28, and also on January 2.

THE DRILLERS employed in Government dockyards have been granted an advance of 2s. weekly, to date from the first pay period following December 1.

THE LONDON IRON AND STEEL EXCHANGE, LIMITED, is holding its annual dinner at the Trocadero Restaurant, London, on Tuesday, January 31 next.

THE BRITISH MANNESMANN TUBE COMPANY, LIMITED, have secured an order for boiler tubes for the All-Russian Co-operative Society, to be shipped to Archangel.

HARLAND & WOLFF, LIMITED, have granted a licence to W. H. Allen, Sons & Company, Limited to manufacture Diesel engines under the Burmeister and Wain patents.

THE WAGES of the Welsh copper workers have been reduced by 12½ per cent. The question of the advance of the age limit from 18 to 21 years has been referred to a committee.

THE wages regulated by the sliding scale under the Midland Iron and Steel Wages Board were reduced 7½ per cent. on Monday, and the new rates will remain in force until February 4.

THE ANTI-ATTRITION METAL COMPANY, LIMITED, have closed their offices at 35, Queen Victoria Street, E.C., and have established another branch at 1, Victoria Street, Westminster, S.W.1.

IT IS OFFICIALLY REPORTED that Messrs. Yarrow & Company's shipbuilding yard at Scotstoun will probably close down about the middle of December, but that the closing will only be for a temporary period.

ON December 3 the new steel foundry of Sutherland, Limited, was formally opened at Belfast. The melting is carried out by an electric furnace of 1½ tons capacity supplied by Electro Metals, Limited, London.

AMSTERDAM PAPERS understand that Mr. Henry Ford, director of the well-known American motor-car works, intends to establish a factory at Antwerp. He will, however, it is stated, buy all the requisites in America.

"THE 'CYC-ARC' PROCESS OF AUTOMATIC ELECTRIC WELDING" was the subject of a paper prepared by Mr. L. J. Steel and Mr. H. Martin, and read at the meeting of the Institution of Electrical Engineers on December 1.

A LECTURE was delivered under the auspices of the Association of Drop Forgers and Stampers by Dr. Leslie Aitchison, in the Mappin Hall, Sheffield, on Wednesday, December 14, entitled "The Testing of Drop Forgings."

MAJOR N. MAAS has been taken into partnership by Mr. A. T. Wall, consulting naval architect and engineer, and in future the firm will trade as A. T. Wall, Maas and Company, 310, Royal Liver Building, Liverpool.

"SOME CHEMICAL problems connected with refractory materials" was the subject of a lecture given recently at Sheffield, in connection with the Sheffield Society of Metallurgists and Metallurgical Chemists, by Mr. A. B. Searle.

WITH A VIEW to extending the company's operations as constructional engineers, particularly in India, the directors of Dorman, Long & Company, Limited, have acquired an interest in the undertaking of Braithwaite & Company (Engineers), Limited.

THE TEES-SIDE BRIDGE AND ENGINEERING COMPANY, LIMITED, have in hand a comprehensive scheme of works extension, in connection with which the company have entered into negotiations with the Middlesbrough Corporation for the purchase of additional land.

A NEW COMPANY has been started in France in order to manufacture and sell under royalty the Monometer furnaces, die-casting machines, temperature controllers, lead pipes and cable plants, etc. This company will have the sole selling rights for both France and Belgium.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to R. Girvin & Company, Limited, 24, St. Mary Axe, E.C.3; Hampshire Metal Company, Limited, Crown Street, Portsmouth; A. Young, 15, Prudential Buildings, Pinstone Street, Sheffield.

CHARLES BARRON & COMPANY, of Craven House, 121, Kingsway, W.C.2, have been appointed sole agents by Combustions, Limited, 24b, High Street, Kingston-on-Thames, for the sale of the "Rotamisor" liquid fuel burner, covering the areas of London, S.E. England, and Birmingham and district.

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION, LIMITED, of London and Darlaston, have secured a contract from the Barrow Hematite Steel Company, Limited, Barrow-in-Furness, for the crane equipment of their new steelworks extension, including ladle crane, charging machine, etc.

THE FIRST REPORT of the War Compensation Court, covering the period from August 16, 1920, to August 16, 1921, issued last week, includes the following awards: Nobel Industries, £4,239; W. Cory & Son, £15,065; Guest Keen & Nettlefolds, £4,550; London, Chatham and Dover Railway, £16,197.

SIR WILLIAM ARROL & COMPANY, LIMITED, have obtained from the Crown Agents for the Colonies the order for the new railway workshops at Enugu (West Africa) for the Nigerian Railways. In addition to the buildings and power station, the order comprises the complete equipment and erection *in situ*.

IT IS UNDERSTOOD, says an American cable report, that seven big steel companies, having a total capital of 467 million dollars, are at the present moment negotiating a merger, which, if concluded, will result in the establishment of an organisation second only in importance to the United States Steel Corporation.

THE WORK OF electrifying the Glencoe-Maritzburg section of the South African State Railways is to be commenced immediately, says "Engineer." The length of the section is approximately 170 miles, and it is to be electrified on the high-tension direct-current system. Messrs. Merz and McLellan are the consulting engineers.

UNDER the auspices of the University College of Swansea and the South Wales Institute of Engineers, Mr. T. J. Gueritte (Paris), president-elect of the Society of Engineers, lectured before the Engineering Association of Students, at Swansea, on the 2nd inst., on "Ferro-Concrete Construction, its Principles and Application."

MESSRS. WHITE BROTHERS, LIMITED, of Itchen Ferry, have received an order for five steamers, to be completed early next year. Four of the vessels, aggregating about 500 tons each, will be 160 ft. long, with 30 ft. beam, and a depth of 14 ft. They will burn oil or coal, and Messrs. Thornycroft will carry out the engineering work.

THE THIRD meeting of the session of the Glasgow section of the Society of Chemical Industry was held recently, in the Institute of Engineers and Shipbuilders, Glasgow. Mr. J. H. Young was in the chair, and Mr. E. H. Lewis, of the Glasgow Iron and Steel Company, Limited, read a paper on "Iron Portland Cement."

ON Friday last the members of the West of Scotland Iron and Steel Institute met in Glasgow, when Mr. P. S. G. Kirk read his paper on "Modern Steam Generators for the Efficient Utilisation of Gaseous Fuels and the Efficient Recovery of Waste Heat." Mr. Kirk is a director of Spencer Bonecourt, Limited.

THE ROYAL METAL TRADES' PENSION SOCIETY are holding their annual dance in the Victoria Hall, Hotel Cecil, on Friday, February 24, 1922. Mr. Edward Le Bas, of Edward Le Bas & Company, Dock House, Billiter Street, London, E.C.3 as chairman of the dance, is making a special appeal for donations on behalf of the society.

PROBABLY THE MOST STRIKING INDICATION of the depression in trade is that furnished by Messrs. Gray & Company, shipbuilders, of West Hartlepool, who are at present paying only £8,000 a month in wages, whereas in January of this year they were paying £18,000 a week. Repair jobs, they state, are still going to the Continent.

ONE vessel only was launched from the Sunderland shipbuilding yards during the month of November. This was the "Andello," launched by Messrs. S. P. Austin & Sons, and having a gross tonnage of 1,830. This makes the total output for the eleven months of the present year 28 vessels, with an aggregate tonnage of 125,727, compared with 61 vessels, and 288,615 tons in the corresponding period last year.

IT IS REPORTED that the Whessoe Foundry and Engineering Company, Limited, Darlington, have recently been awarded by the Admiralty the contract for the supply and erection in Singapore of 10 steel oil-fuel tanks, each 116 ft. in diameter by 45 ft. 6 in. Each tank will be capable of holding about 12,000 tons of oil—probably a larger capacity in one unit than any oil storage tanks hitherto constructed.

IRON AND STEEL MARKETS.

Pig-iron.

The near approach of the holidays and the continued lack of a general demand for pig-iron will readily explain the prevailing quietude of markets, in which very little interest is now taken, and buying is reduced to almost nominal limits. Reports from all the principal centres of the industry confirm the depressing conditions of the trade, and even the most optimistic opinion suggests little hope of any substantial improvement during the ensuing quarter. As evidencing the restricted production at the present time it may be noted that in Scotland only 18 furnaces are in operation, 17 being engaged in the production of foundry qualities and one hematite. With business very restricted makers are finding it extremely difficult to dispose of the output, and there is a prospect of some of the furnaces being blown out. In the Midlands, although prices have steadily declined, business continues weak, with buying on hand-to-mouth lines, with but faint hopes of more Staffordshire blast furnaces being recommissioned till well on in the New Year. Demand will have to undergo marked improvement before smelters will be tempted to expand their operations, and it is felt that the speeding up of demand will depend very much on what the railway companies decide in regard to rates. Cleveland iron markets last week were entirely destitute of activity, the recent reductions in prices having so far completely failed to attract buying except for the most urgent requirements, while export transactions were also confined to very occasional parcels. It is, however, satisfactory to learn that imports of foreign pig into Tees-side, which have averaged 20,000 tons per month, have now practically ceased, the recent cuts in Cleveland iron prices bringing the home product down to about the same level in values as the metal from abroad. Awaiting the anticipated decision of the railway companies on the subject of rates revision prices are unaltered, Cleveland No. 1 selling at 105s. per ton, No. 3 G.M.B. at 100s., No. 4 foundry at 95s., No. 4 forge at 90s., and mottled and white at 85s.

The output of East Coast hematite will be increased almost immediately by the restarting of four more blast furnaces, and competition for orders, already keen, is certain to increase. The price tends steadily downward, and mixed numbers can now be obtained at 105s., though 110s. is still asked for small lots, with No. 1 at a premium of 2s. 6d. West Coast hematite is down 10s., Bessemer mixed numbers making 125s. per ton, delivered Sheffield.

Finished Iron.

Very little actual business is reported in the various sections of the finished iron trade, nor can any material improvement be expected until the turn of the year. Many of the works are only partially employed, and although a few inquiries are now in circulation for export account, buying is chiefly confined to immediate necessities, consumers being mostly persuaded that lower levels of values will shortly place them in a more advantageous position. It is, however, difficult to estimate the near approach to anything like normal basis prices in existing conditions, although probably some relief from the present heavy railway freightage imposts may have an effect in that direction. In South Staffordshire there are more complaints of under-selling in the commoner qualities of bar iron, of which the Association price was recently reduced to £13 for all grades, outside makers, it is reported, offering at as much as 5s. per ton below that figure to secure orders. The position of the marked bar makers is relatively stronger, though suffering in common with others as a result of the cancellation of battleship contracts, in connection with which orders had already been placed.

Steel.

Although without perceptible change, conditions in the steel trade are certainly less hopeless than was reported a short time back, due, not so much to any activity in buying, but to some increase in the volume of inquiries, and the propect of their materialising in actual business in the near future. At Sheffield some fair purchases of billets are reported of late, acid qualities being disposed of at £13 for Siemens and £12 10s. for Bessemer, while the quotations for hard and soft basic billets are £9 and £7 10s. respectively, delivered, though the latter are said to have been done at several shillings below that figure. Open-hearth and crucible steel are as slack as ever. Wire rods have declined to £11 10s. for soft basic, while hard basic sorts are quoted at about £15. There is a comparatively fair amount of business in bright steel bars at £20, but virtually nothing doing in high-speed steel, although a satisfactory feature is the growing demand for constructional steel for motor cars that is now in evidence. In the West of Scotland steel makers faced with keen competition from producers in England, are urgently in need of orders, and though quotations are nominally £10 10s. for ship plates and £10 for angles, for delivery in the Clyde area, a customer with a good line to place would have little difficulty in securing concessions. Last week makers decided upon a reduction of 30s. per ton in boiler plates, and the quotation is now £14 per ton for deliveries in Scotland.

Scrap.

Reports from most of the principal markets for scrap metal indicate very quiet conditions prevailing, the majority of consumers having already sufficient stocks of metal in hand to carry them well over the ensuing holidays. In the Midlands, the only exception, perhaps, to the general rule, steel turnings are decidedly firmer. In several cases 35s. has been offered, and parcels have changed hands at that figure. Steel scrap is also firm at £2 10s. to £2 15s., while wrought-iron scrap for piling purposes is steady at £3 15s. delivered, and balling scrap at £3 to £3 5s. Cast-iron scrap is still weak, and there is not a very great demand. Transactions are, however, taking place in small quantities at prices ranging from £4 10s. to £5 for heavy machinery cast-iron scrap and £3 to £3 10s. for light cast iron.

Tinplates.

Conditions in the tinplate market remain steady, but prices are reported a shade easier, owing to decreasing inquiries on export account, while speculative buying has also fallen off to some extent. Most of the makers, however, are fairly well booked over the end of the current year, and work at the mills is progressing fairly satisfactorily. Prompt parcels of plates are in somewhat active demand, the figures quoted ranging round 22s. per box basis for coke finish, net cash, f.o.b. Wales, but for forward delivery, say, over the first quarter, 21s. is freely quoted, and transactions were reported down to 20s. 6d. basis. Wasters are in fair demand, C.W. 28 by 20 rule firm at 41s., and C.W. 14 by 18¾ have hardened up to 20s. 6d. C.W. 14 by 20 are steady at 19s. 6d. All f.o.t. at works. Terneplates are in moderate request, 20s. 6d. basis is generally quoted for approved specifications, net, f.o.b.

Metals.

Copper.—Opening with more favourable American advices the market for standard copper here developed a stronger tone, buying for the three months' position becoming quite animated until the close. The home demand is, however, still restricted in scale, a by no means unusual condition towards the end of the year, and little improvement in this respect can be anticipated until the holidays are over. An increased turnover was reported, with December-January marked at £67, and March was done at £67 15s. The improvement in the American exchange was reflected in the market for refined copper, electrolytic declining 20s. to £74 to £75 10s., with wire bars down at £75 to £75 10s. Closing prices:—Cash: Wednesday, £67 2s. 6d.; Thursday, £67 2s. 6d.; Friday, £66 15s.; Monday, £66 17s. 6d.; Tuesday, £66 12s. 6d. Three months: Wednesday, £68 5s.; Thursday, £68 2s. 6d.; Friday, £67 15s.; Monday, £67 17s. 6d.; Tuesday, £67 12s. 6d.

Tin.—Encouraged by the latest Eastern advices, reporting Singapore as sellers at £171 10s. c.i.f., the market for tin on this side was further stimulated by American cablegrams, and buying, mostly on forward account, became active, £171 being paid for February delivery, while March was done at £173. December sold at £170 10s. to £171 10s.; January, £171 to £171 15s.; and February, £171 to £172 5s., the market closing strong with English ingots advanced 55s. at £170. Stocks of tin in London warehouses show a decline of 241 tons on the week, at 5,287 tons, Liverpool an increase of eight tons at 2,323, with Swansea unchanged at ten tons. Closing prices:—Cash: Wednesday, £167 5s.; Thursday, £166; Friday, £168 2s. 6d.; Monday, £171 5s.; Tuesday, £169 15s. Three months: Wednesday, £169; Thursday, £168; Friday, £169 15s.; Monday, £173; Tuesday, £171 10s.

Spelter.—The market for this metal has disclosed moderate activity in dealings, with fractional advances for both near and forward account. Closing prices:—Wednesday, £26 15s.; Thursday, £26 17s. 6d.; Friday, £26 12s. 6d.; Monday, £26 17s. 6d.; Tuesday, £26 17s. 6d.

Lead.—During the current week a fairly brisk demand has developed in the market for soft foreign pig, and with sellers again reserved prices have stiffened, near dates closing 5s. and forward 7s. 6d. higher. December sales were marked at £25 17s. 6d. to £25 15s.; January, £25 10s.; and March, £25 to £25 2s. 6d. English closing prices: Wednesday, £26 15s.; Thursday, £26; Friday, £26 15s.; Monday, £27; Tuesday, £27.

XUM

Company News.

Davy Brothers, Limited.—Interim dividend, 2½ per cent., less tax.

Netherton Engineering Company, Limited.—Cap'tal £500 in £1 shares.

Wilkes, Limited.—Final dividend, 10 per cent. per annum, making 10 per cent. for year.

The Mint, Birmingham, Limited.—Interim ordinary dividend, 10 per cent. per annum, free of tax.

"The Coventry" Chain Company, Limited.—Final ordinary dividend, 7 per cent., less tax, making 10 per cent. for year.

Ramsay Engineering Company, Limited. — Capital £40,000 in 5,000 preference shares of £1 and 140,000 ordinary of 5s.

Latona Engineering Company, Limited. — Capital £10,000 in £1 shares. Directors: Mrs. J. D. Hayward and A. Curgenven.

Millom & Askam Hematite Iron Company, Limited.—Final ordinary dividend, 3 per cent., tax free, making 5 per cent. for year.

Bromsgrove Guild, Limited.—Capital £20,000 in £1 shares. Metal manufacturers. Registered office: Station Street, Bromsgrove, Worcs.

W. H. Dorman & Company, Limited.—Net loss on year's trading, £223,000; brought forward, £43,947; preference dividend, £6,657; debit balance, £186,003.

Tube Investments, Limited. — Profit, £60,433; brought forward, £32,991; available, £93,424; ordinary dividend, 8 per cent. for year, less tax; carried forward, £40,165.

Gare Industries, Limited. — Capital £6,000 in £1 shares. Engineers. Directors: Lt.-Col. H. C. King and F. B. Spencer. Registered office: 25, Victoria Street, Westminster, S.W.1.

John I. Thornycroft & Company, Limited.—Dividends, 3 per cent. on preference, making 6 per cent. for year; 3¾ per cent. on participating preferred ordinary, making 7½ per cent.; and 7½ per cent. for year on ordinary.

Blyth Shipbuilding & Dry Docks Company, Limited.—Profit, £29,503; brought forward, £4,026; available, £33,529; debenture interest, £7,686; final dividend, 1s. 3d. per share, making 2s. per share; carry forward, £7,550.

Brown, Bayley's Steel Works, Limited.—Profit, including balance brought forward, £29,456; preference dividend for two months ended August 31, £4,166; final ordinary dividend, 2½ per cent., less tax, £5,250; carry forward, £20,040.

John Hawthorn & Company, Limited.—Capital £10,000 in £1 shares. Engineers, etc. Directors: Mrs. Mary Liddell, A. Liddell, R. Liddell, and W. Liddell. Secretary: R. Liddell. Registered office: Canal Foundry, Newtown, New Mills, near Stockport.

Ford Welding & Engineering Company, Limited.—Capital £5,000 in £1 shares. Directors: Gertrude Ford, K. MacBean, E. Holbrook, and C. J. Wiltshire. Secretary: K. MacBean. Registered office: The Works, The Tunnell, off Queen Street, Cardiff.

Dorman, Long & Company, Limited. — Profit, £413,799; brought forward, £248,540; available, £662,339; ordinary dividend, 2½ per cent., making 5 per cent. for year; interest on calls paid in advance, £11,863; expenses re share issue, £1,226; debenture redemption, £10,477; carried forward, £239,488.

Personal.

THE LATE MR. LEGG, of Robert Legg, Limited, City Engine Works, Eagle Wharf Road, N., left £7,003.

MAJOR F. T. WRIGHT has been appointed electrical engineer to the Bombay, Baroda and Central India Railway.

MR. C. E. LLOYD, chairman of Hingley & Sons, Limited, Netherton Ironworks, is the prospective candidate for Dudley.

THE LATE MR. W. NEILSON, a director of the Summerlee Iron Company, Limited, left personal estate of the value of £74,567.

MR. G. W. SOMERVILLE has been appointed manager of the electrical department of Joseph Walton & Son, Walverden Foundry, Nelson.

MR. H. E. REA has retired from the directorate of David and William Henderson & Company, Limited, Meadowside Works, Partick, Clyde.

MR. J. MILNE, of the Statistical Department of the Ministry of Transport, has been appointed an assistant to the general manager of the G.W.R.

THE LATE MR. F. Platt, J.P., chairman of Samuel Platt, Limited, left estate of the gross value of £138,208, with net personalty £39,817.

MR. L. CHANDLER, managing director of the Metropolitan Carriage, Wagon and Finance Company, Limited, has resigned that position. He was formerly head of the Patent Shaft and Axletree Works at Wednesbury.

Gazette.

THE BEAVER ENGINEERING COMPANY, LIMITED, are being wound up voluntarily. Mr. D. D. Halliday, 11, Spring Gardens, Manchester, has been appointed liquidator.

THE VAUXHALL METAL & MACHINE WORKS, LIMITED, are being wound up voluntarily, with Mr. A. C. Vincent, 13, Queen Street, Cheapside, London, E.C.4, as liquidator.

MR. D. RUSSELL, carrying on business as D. Russell & Company, Suffolk House, 5, Laurence Pountney Hill, London, E.C., iron and steel merchants, is paying a dividend of 5s. in the £.

TRADING in the style of Wilson Haigh & Company, Messrs. H. R. Wilson and J. W. Pattison, 50, Grey Street, Newcastle-on-Tyne, and at Sunderland, iron and steel merchants, have dissolved partnership. Debts by H. R. Wilson.

THE Townmead Engineering Works, Limited. A petition has been presented by Messrs. Jacobs Brothers, 29, Duke Street, St. James's, S.W., for liquidation of the company. Mr. M. A. Jacobs, 73 and 74, Jermyn Street, S.W. solicitor.

TRADING in the style of Thos. Sutton & Sons, Messrs. W. Sutton, E. Linyard, and J. R. Sutton, Ablow Street, Wolverhampton, lock manufacturers, brass founders, etc., has dissolved partnership. Debts by J. R. Sutton, who continues the business.

THE Universal Machinery Corporation, Limited. It has been resolved, November 25:—That the company be wound up voluntarily. Mr. H. Button, 61 and 62, Lincoln's Inn Fields, W.C., chartered accountant, has been appointed liquidator.

TRADING in the style of W. A. Foot & Company, Messrs. G. W. Norris, S. H. Crosfield, and C. K. Butt, Orchard Street and Dorset Street, Blandford, engineers and machinists, have dissolved partnership. Debts by G. W. Norris and S. H. Crosfield, who continue the business.

THE Ramsay Marine Engineering Company, Limited. It has been resolved that it is desirable to reconstruct the company, and accordingly that the company be wound up voluntarily. Mr. F. Morse, 1 and 2, Great Winchester Street, E.C., accountant liquidator, who is authorised to consent to the registration of a new company.

UNDER THE compulsory liquidation of the Gardiner Shipbuilding and Engineering Company, Lake Shipyard Poole, accounts have been lodged showing gross liabilities £558.271 and assets valued at sufficient to provide a surplus of £7,310 after payment of the debts, but a deficiency of £224,490 as regards contributories. Lieut.-Colonel J. Grimwood has been appointed as liquidator of the company.

Patent Abstract.

Particulars of Complete Specification accepted, furnished by Mr. Eric Potter, Patent Agent, 27, Chancery Lane, W.C.2, and Albert Street, Nottingham.

Printed copies of the Specifications in the following list will be on sale December 15, 1921.

147,624. WINDHAUSEN, F. Method of and apparatus for casting metals. (December 8, 1913.)

151,254. ACME DIE CASTING CORPORATION. Casting curved tubular bodies. (April, 21 1920.)

171,750. FISHER, W. H., and CHAMBERS, P. Apparatus for the cementation of iron and iron alloys, and process thereof. (August 13, 1920.)

150,290. SHUTTS, B. A., and GOODWIN, J. O. Moulding devices for use in casting pig-iron. (August 18, 1919.)

171,888 BRENNAN, F. Core-boxes of core-making machines. (November 9, 1920.)

Publications Received.

Messrs. Edward Le Bas & Company, London, Glasgow and Manchester. List price of welded gas, steam and water tubes and malleable fittings.

Messrs. Isles, Limited, Stanningley, Leeds, have just issued a well-illustrated catalogue under the title of "Cranes," containing particulars of their latest specialities of all types and powers of lifting machinery.

Messrs. Lep Transport and Depository, Limited, Castle Street, Long Acre, London, W.C.2. "Lep Transport Manifesto," an illustrated descriptive brochure of the firm's export and import service at home and abroad.